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How the Information on Science and Technology Activities Should be Sent to Younger Generations

: Based on the Analysis of the High School Student's Attitudes toward Career Selection and Science & Technology

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C O N T E N T S

1. Objective and method of the study

1.1 Objective of the study

NISTEP analyzed the job selection tendencies of university students and the career selection problems of university-minded senior high school students, to study the actual situation of the young people's drift away from science and technology and the conditions for securing competent young scientists and engineers. NISTEP published the analytical results in 1989 and 1990 (References 1 and 2). Furthermore, a series of studies on the relation between the science & technology and the society conducted by NISTEP included the analysis on the relation between young people and science & technology (Reference 3). Also thereafter, NISTEP inherited the critical mind and results of those studies, and analyzed more deeply the correlation between young people and science & technology.

A series of these analytical results reveals the actual situation on the relation between young people and science & technology particularly in young people's career selection. It suggests that in order to tempt potentially competent people to more positively grapple with science and technology, it is necessary to intensify the information on scientific and technological activities presented to young people in such a manner as suitable for the present age when the fruits of latest science and technology abundantly exist as consumables around us. This report publishes the results of these analyses and also the results of discussion as to how to present the information on scientific and technological activities to young people.

The correlation between young people and science & technology is important for the promotion of science and technology in two aspects. In one aspect, some young people will be directly engaged in future scientific and technological activities (by entering science- and engineering-related departments in universities and by being engaged in the jobs concerned with science and technology). In the other aspect, young people will keep relations with science and technology by accepting the fruits of science and technology to support scientific and technological activities in future as full-fledged members of the society.

Both the aspects are surmised to relate to each other. But under the present education scheme, the two aspects in the correlation between young people and science & technology begin to separate when they are going to enter universities. Students who have selected the science and engineering majors are promising candidates for future scientists and engineers. But those who have selected humanities and social science majors seldom become scientists and engineers. So, the university students' attitudes toward and consciousness of science and technology do not have relations with their career selection as scientists and engineers or others. However, senior high school students' attitudes toward and consciousness of science and technology are surmised to have relation with their wish to be scientists and engineers.

This study analyzes senior high school students' general attitudes toward and consciousness of science and technology, the

actual situation of their consciousness to participate in scientific and technological activities, and the correlation between both of them, and discusses the functions of the information on scientific and technological activities received by young people. This report

1) Analyzed senior high school students' consciousness of career selection and of science & technology.
2) Identified both the consciousness structurally and analyzed their correlation.
3) Discussed the functions of the information on scientific and technological activities.

The objective of the study is to discuss, through the above efforts, how to present to young people the information on the activities of science and technology themselves, the images of scientists and engineers themselves, etc., in short, the information on scientific and technological activities through households, elementary and secondary education, mass media and scientists & engineers in the present highly advanced science and technology society.

1.2 Method of the study

For this objective, this study re-analyzed "A survey on senior high school students' career selection" (Reference 2 : hereinafter called "the previous report"). The survey reported in the previous report was performed as follows:

Subjects:	4211 third-year students of 22 public senior high schools large in the number of university-minded students throughout Japan
Time:	November, 1989 to January, 1990
Method:	Students were asked to fill out questionnaires simultaneously in their classrooms.
Questions:	Intended major and its factors, image of university life, job selection and images of jobs, attitudes toward and consciousness of science and technology, etc.

The present study analyzed the replies of 3879 university-minded students out of 4211 answerers.

The previous report divided the intended majors into two courses of natural science & engineering (hereinafter showed "NS &E") and non-natural science (hereinafter showed "non-NS&E) for analysis. But the present study classified the students in reference to the departments wished to be selected, the school phases when the career to be selected was decided, and the experience of having once wished to select the other course, to analyze the differences in their consciousness of career selection and their views of science and technology among the respective classified groups. In general, since the consciousness items stated in the questionnaire do not properly cover all the consciousness concerned, it was attempted to extract and discuss the essential structures irrelevant to individual question items,

by identifying the structures through multivariate analysis such as factor analysis of the replies to several questions.

The following summarizes the results of the survey, and presents proposals as to how to present the information on scientific and technological activities to young people. Furthermore, the appendices give the details of results of individual analyses.

2. Results of the survey

2.1 University entrance examinees' consciousness of their career selection and views of science and technology by intended major

The consciousness of career selection and the views of science and technology identified for respective departments wished to be selected were analyzed, and it was found that the consciousness of career selection and the attitudes toward science and technology are delicately different from department to department even within the same NS&E course or non-NS&E course.

The results of analysis on the consciousness of career selection and the attitudes toward and consciousness of science and technology can be summarized as follows for respective departments wished to be selected. (For the details of the analysis, see Appendix 1.)

[NS&E courses]

<1> Students wishing to select the physical science-related department

About 50% of the students decided their course by around the second year of junior high school, and many of them are good at mathematics, chemistry and physics and have a self-image of "like scientific experiments, etc.". On the other hand, they tend to be relatively weak in social studies, Japanese language and English language which are surmised to relate to communication with people, and form a passive group on the questionnaire items concerned with communication with people such as "communication with others" and "reading and writing sentences". Furthermore, for decision of their course, they give priority to such study aspects as "can study what I like", "like to theoretically pursue the principles and mechanisms of things", "wish to learn leading matters of today" etc., and as for university life, they give priority to "my hobby" and "study and research". In the future, they wish to select a job which meets "can do what I like", "can use my knowledge and techniques" or "can be dedicated to one speciality".

For the views of science and technology, they are very interested in the trends of science and technology and positive in utilizing them. As their future jobs, about 60% of them wish to be scientific and technological researchers.

<2> Students wishing to select the engineering-related department

Like the students wishing to select the science-related department, about 50% of the students decided their course by around the second year of junior high school. They are good at physics, mathematics and chemistry, and many of them have a self-image of "like handicraft" or "like mechanisms". On the other hand, they tend to be relatively weak in Japanese language, social studies and English language surmised to relate to communication with people, and form a passive group on such items concerned with communication with people as "reading and writing sentences" and "communication with people". For the decision of their course, they give priority to "can study what I like", "wish to learn leading matters of today", etc., and for university life, they wish to spend energy for "my hobby", "relations with friends", etc. For future, they wish to select a job which meets "can do what I like", "can use my knowledge and techniques", "high stability" or "good salary".

As for the image of university life in the NS&E course, they most strongly feel, among all the students wishing to select the NS&E course, that the NS&E course is "advantageous for employment" and "future promising".

The views of science and technology are the same as those of the students who wish to select the science-related department.

As for future jobs, about 70% wish to be engineers (including those of information processing).

<3> Students wishing to select the medical/dental-related department

Like the students wishing to select the science- and engineering-related departments, about 50% of the students decided their course by around the second year of junior high school. They are good at biology, English language and chemistry, and many of them have a self-image of "like keeping living creatures" or "like scientific experiments, etc.". As for the subjects they are weak in, the number of those who are weak in social studies is somewhat larger than the corresponding numbers of the students wishing to select other departments, but is not so conspicuous. They cannot be said to be passive in the items concerned with communication with people such as "communication with people" and "reading and writing sentences". When deciding their course, they refer to "talking with parents", etc., and give priority to "can study what I like" and "wish to have a license". For university life, they give priority to "study and research", "acquisition of license" and "relations with friends", and they feel "busy with studying" most strongly among all the students wishing to select the NS&E course.

For future, they wish to select a job which meets "can do what I like", "can use my knowledge and techniques", or "can contribute to the society".

As for the views of science and technology, they are rather strongly interested in the trends of science and technology, but form a rather passive group in the use of science and technology,

among all the students wishing to select the NS&E course.

As regards future jobs, about 90% wish to be engaged in medical services.

[Non-NS&E courses]

<1> Students wishing to select the law-related department

In general, though these students are late in deciding their course compared to those wishing to select the NS&E course, less than 40% of the students decided to select their course by their second year of junior high school. They are relatively good at social studies, Japanese language and English language, and weak in physics, mathematics and chemistry. Furthermore, many of them have a self-image of "interested in social events" or "like reading and writing sentences". For decision of their course, they give priority to "can study what I like", "interested in social mechanisms and movements" and "wish to enjoy university life". As regards university life, they give priority to "relations with friends" and "my hobby".

For future, they wish to select a job which meets "can do what I like", "high stability" and "good salary". As for the views of science and technology, they cannot be said to be either positive or passive for utilizing the fruits of science and technology, but are less interested in the trends of science and technology.

For future jobs, about 70% wish to be mainly engaged in office work (29% of which wish to be judicial professionals, and 25%, public officers).

<2> Students wishing to select the economics-related department

These students are late in deciding their course compared to those wishing to select the NS&E course, and only less than 20% decided by their second year of junior high school. They are relatively good at social studies, and weak in physics and chemistry. Many of them have a self-image of "like communication with people", and in the decision of their course, they give priority to "wish to enjoy university life" and "interested in social mechanisms and movements". As for university life, they wish to give priority to "relations with friends", "my hobby", etc.

Their attitudes for selection of jobs and views of science and technology are similar to those of the students wishing to select the law-related department.

For future jobs, about 70% wish to be mainly engaged in office work (31% of which wish to be business experts of finance and distribution).

<3> Students wishing to select the commercial science/business administration-related department

The timing of course decision, self-image, priority items

for course decision and priority items for university life are almost the same as with the students wishing to select the economics-related department. They are relatively good at social studies and weak in chemistry, physics and earth science. As regards the views of science and technology, they are positive in utilizing the fruits of science and technology, but are rather less interested in the trends of science and technology. Compared to the students wishing to select other non-NS&E departments, they have an image that the university life in the non-NS&E course is "future promising".

For future jobs, about 70% wish to be mainly engaged in office work (27% of which wish to be business experts of finance and distribution).

<4> Students wishing to select the literature-related department

Their timing of the course decision is almost the same as that of the students wishing to select the law-related department. They are rather good at Japanese language and social studies, and weak at mathematics, physics and chemistry. This group is most remarkable in the self-image of "like reading and writing sentences". In the decision of their course, they give priority to "can study what I like", "wish to enjoy university life", "wish to think about human beings and life", etc., and as regards university life, they wish to give priority to "my hobby", "relations with friends", "study and research", etc. They strongly feel that the university life in the non-NS&E course is "disadvantageous for employment" compared to the students wishing to select the law- economics-, and commercial science/business administration-related departments. In future, they wish to find a job which meets "can do what I like", "can use my knowledge, etc." or "high stability".

For the views of science and technology, they are less interested in the trends of science and technology than those wishing to select the other departments of the non-NS&E course.

As regards future jobs, about 40% wish to be mainly engaged in the jobs concerned with the presentation of information to the society (experts of mass media and literature).

<5> Students wishing to select the education-related department

The timing of the course decision by these students is almost the same as that by those wishing to select the law- and literature-related departments. They are good at Japanese language and weak in physics, chemistry and mathematics. As for self-image, this group is large in the number of students who have an image of "like communication with people". For decision of their course, they give priority to "can study what I like", "wish to acquire a license", "wish to enjoy university life", etc., and as for university life, they wish to give priority to "relations with friends", "acquisition of license" and "my hobby". They do not have an image that the university life in the non-NS&E course is "advantageous for employment", compared to the students wishing to select the law-, economics-, and commercial science/business administration-related departments. For

job selection, they are almost the same as those wishing to select the literature-related department.

Furthermore, also for the views of science and technology, they are the same as those wishing to select the literature-related department, and form a group least interested in the trends of science and technology.

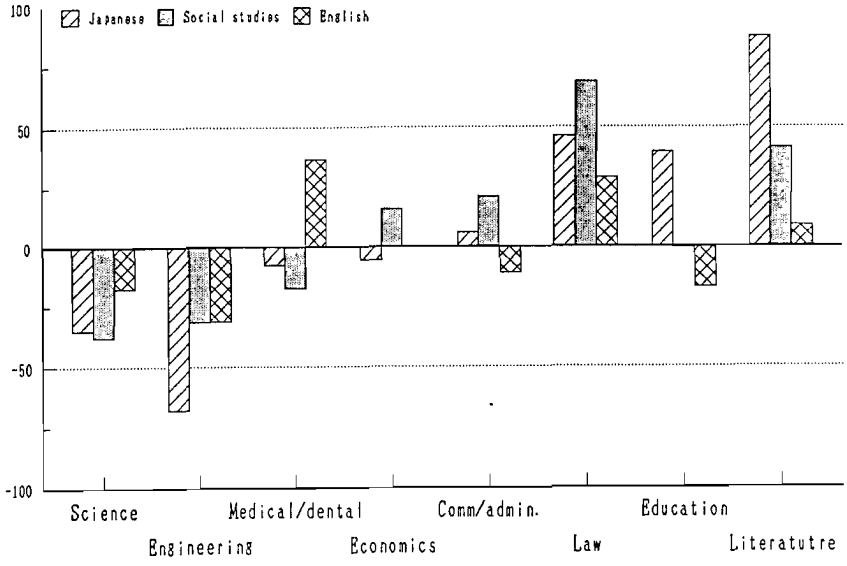
For future jobs, about 70% wish to be engaged in education.

As briefly described above, even among the students wishing to select the NS&E course, there is a difference between those wishing to select the science- and engineering-related departments and those wishing to select medical/dental-related department. Especially those wishing to select the science- or engineering-related department are weak in such subjects as Japanese language, social studies and English language surmised to relate to communication with people (Fig. 1) and form a group passive about "communication with people" and "reading and writing sentences" in their self-image of communication with people, compared to those wishing to select the medical/dental-related department. So, the competent persons of science- and engineering-related departments generally form a group which is poor in the ability to communicate with people and tend to be poor in the ability to vividly present their activities to the society (hereinafter called "the society-oriented information presentability"), as a matter of apprehension.

As another matter of apprehension, the students wishing to select the literature- and education-related departments which are supposed to produce many competent persons working in mass media and educational services who are surmised to greatly affect the career selection by the young people of the next generation form a group least interested in science and technology.

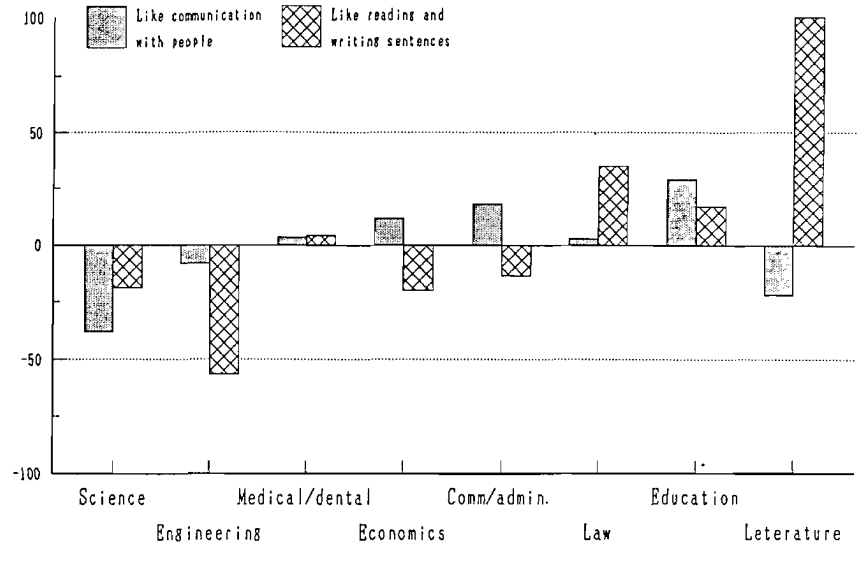
As for the university-minded students' consciousness of their subjects, it was found that they tend to be very conscious of being weak in natural science-related subjects such as physics, earth science, chemistry and biology, compared to social studies and Japanese language. This must suggest that the present education at schools does not function sufficiently for natural science-related subjects, making students conscious of being weak in those subjects, to further promote their drift away from the NS&E course.

Fig. 1 Students who are good at or weak in communication-related subjects by intended major



Note: Scores for being good or weak were given as follows.... +200 for "very good", +100 for "rather good", -100 for "rather weak" and -200 for "very weak". For each subject, the average of scores of students for each department was subtracted from the average of all the students, to be expressed in this graph.

Fig. 2 Student's self-image of communication by intended major



Note: Scores for being good or weak were given as follows.... +200 for "very good", +100 for "rather good", =100 for "rather weak" and -200 for "very weak". For each subject, the average of scores of studnets for each department was subtracted from the average of all the students, to be expressed in this graph.

2.2 School phases when the intended major has been decided and decision factors

The previous report indicated that the students wishing to select the non-NS&E course tend to be later in the decision of career selection than those wishing to select the NS&E course. This induces a surmise that the school phases when the intended major has been decided may have any relation with the courses wished to be selected. So, this relation and the factors for deciding career selection were analyzed based on basic summation table "By school phase when the intended major has been decided, by whether or not the answerer had once wished to select the other course". (For detailed analysis, see Appendix 2.)

(1) School phases when the intended major has been decided and selected courses

The relation between the school phases when the intended major has been decided and the intended major is analyzed, and it is clarified that

1) the later the school phase when the intended major has been decided, the more students tend to select the non-NS&E course (see Fig. 3), and

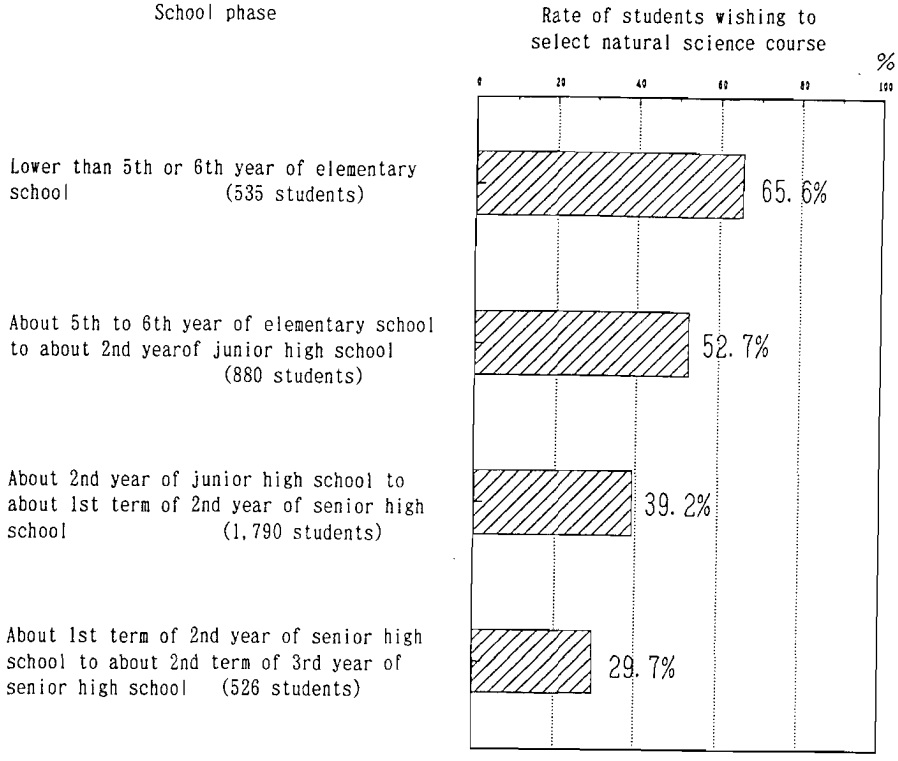
2) the rate of the students who had once wished to select the NS&E course but later changed their minds to select the non-NS&E course is larger than that of the students who changed their minds reversely. That is, 11.9% of the students who had wished to select the NS&E course till about the first term of the second year of senior high school changed their minds to select the non-NS&E course, but the students who changed their minds reversely only accounted for 2.1%. Furthermore, 22.0% of the students who wish to select the non-NS&E course had once wished to select the NS&E course, while the students who had once wished to select the non-NS&E course but changed their minds to select the NS&E course accounted for only 7.2% of all the students wishing to select the NS&E course.

(2) Factors for deciding career selection in respective school phases when the intended major has been decided

The students who have decided to select the non-NS&E course in the second to third year of senior high school seem to be affected by a strong desire for enjoying university life.

On the other hand, the factors which affect the career selection between the NS&E course and the non-NS&E course in the stage of elementary school and junior high school can be summarized as shown in Table 1. It can be seen that essential factors work compared to the factors working in the stage of 2nd to 3rd year of senior high school.

Fig. 3 Rates of students wishing to select the NS&E course by school phase



Note: Each parenthesized number of students means the number of students who replied they had decided the selection in each phase.

Table 1 Factors for deciding the career selection between NS&E course and non-NS&E course in the stage of elementary school and junior high school

Item	Factor to promote the selection of natural science course	Factor to promote the selection of non-natural-science course
Preference of subjects	Good at physics, chemistry and matehmatics, and very weak in Japanese language and social studies	Good at Japanese language, English language and social studies and weak in mathematics, chemistry, physics and earth science
Matters stimulating keen intel-lectual curiosity	Keenly interested in the principles and mechanisms of things, natural phenomena and fabrication	keenly interested in societies of foreign countries, life and social mechanisms
Job wished to be se-lected in future	Priority given to speciality of knowledge, such as being able to utilize knowledge or being able to be dedicated to one speciality.	Priority given to speciality of knowledge, such as being able to utilize knowledge or being able to be dedicated to one speciality (not so strong as the factor for promoting the selection of natural science course).

From the above, it can be seen that the drift away from the NS&E course may be caused in two stages. In one early stage, essential factors (preference of subjects, matters stimulating keen intellectual curiosity, etc.) greatly affect the decision of the career to be selected, and in the other later stage of 2nd to 3rd year of senior high school, superficial factors (wish to enjoy university life, etc.) affect the decision.

2.3 Suggestions found in the examinees irresolute in the their career selection between NS&E course and non-NS&E course

The consciousness of the students who had once wished to select the NS&E course but finally decided to select the non-NS&E course may typically indicate the factors which inhibit the selection of NS&E course, and analyzing the factors is expected to give important suggestions in considering the methods for preventing the drift away from the NS&E course. The existence of the students who had once wished to select the other course, i.e., the students irresolute in their career selection between the NS&E course and the non-NS&E course is important. The following summarizes the results of analysis made on the students irresolute in their career selection between the NS&E course and the non-NS&E course. (For detailed analysis, see Appendix 3.)

The students who had once wished to select the other course, i.e., the students who had once wished to select the non-natural-science course but finally changed their minds to select the NS&E course and those who finally changed reversely are as shown in Table 2.

Table 2 Numbers of students who had once wished to select the other course, and the best three departments wished to be selected in each group

	Number of students	Department wished to be selected
Student who has consistently wished to select natural science course	1,553	<1> Engineering (46.7%) <2> Science (15.8%) <3> Medical/dental (13.3%)
Student who had once wished to select non-natural-science course but changed his mind to select natural science course	120	<1> Engneering (27.5%) <2> Medical/dental (22.5%) <3> Science (18.3%)
Student who has consistently wished to select non-natural-science course	1,606	<1> Law (20.3%) <2> Economics (16.8%) <3> Literature (14.3%)
Student who had once wished to select natural science course but changed his mind to select non-natural-science course	452	<1> Economics (22.6%) <2> Law (16.8%) <3> Commercial/ administration (12.2%)

The students who had once wished to select the other course account for 15% of all the students. Seven percent of the students wishing to select the NS&E course had once wished to select the non-NS&E course, while 22% of the students wishing to select the non-NS&E course had once wished to select the NS&E course. From a certain point of view, this suggests that the students wishing to select the NS&E course are more liable to change their minds to finally select the non-NS&E course.

Among the departments wished to be selected by the students who had once wished to select the non-NS&E course but changed their minds to finally select the NS&E course, the medical/dental-related department is mostly wished to select. On the other hand, among the departments wished to be selected by the students who had once wished to select the NS&E course but changed their minds to finally select the non-NS&E course, the economics- and commercial science/business administration-related departments are wished to select more often.

Among the students who had once wished to select the NS&E course but changed their minds, about one half changed their minds in the stage of 2nd to 3rd year of senior high school. On the other hand, the students who changed from the non-NS&E course to the NS&E course changed their minds earlier.

The outstanding features of the students who had once wished to select the NS&E course but changed their minds, compared to the students who have consistently wished to select the NS&E course were analyzed, to discuss the factors promoting the change from the NS&E course to the non-NS&E course. As a result, the following factors can be identified.

<1> Consciousness of being weak in natural science-related subjects
<2> Wish to enjoy university life and future life affluence
<3> Desire for merits in social life
<4> Tendency to refer to external information (of mass media and seniors) in deciding the career to be selected
<5> Image that jobs of science and technology are less sociable
<6> Tendency to evaluate in reference to brightness and darkness
<7> Lack of interest in scientific and technological activities

From the viewpoint of how to present the information of scientific and technological activities to young people as the subject of this report, it is surmised necessary to improve the presentation of information from the standpoint of intensifying young people's interest in scientific and technological activities, including the information presented in the field of education, the information given through mass media and the information given by senior acquaintances.

Especially with regard to the information given by senior acquaintances, as shown in the analysis of Appendix 3, managers & engineers and office workers who belong to the class in the society which is most likely to affect the high school students vacillating in the career selection between the NS&E course and the non-NS&E course tend not to evaluate the social position of scientists highly (Table 3), and this can be said to be a serious problem confronting our intention to intensify young people's

interest in scientific and technological processes.

Table 3 Recognition on the social position of scientists by people in respective occupational categories (replies to a question, "Do you think the social position of scientists is generally high?)

Occupational category	Marks
1. Agriculture, forestry and fishery (proprietor)	71.2
2. The jobless other than housewives and students	65.6
3. Agriculture, forestry and fishery (employed family members)	57.1
4. Physical workers (employed)	48.1
5. Commercial and industrial services and free lancers (proprietors)	42.5
6. Commercial and industrial services and free lancers (employed family members)	40.9
7. Students (jobless)	39.0
8. Housewives (jobless)	38.9
9. Office workers (employed)	26.3
10. Managers and engineers (employed)	2.4

Note 1: The following scores were given to respective answers; 300 to "Absolutely yes", 100 to "Yes", 0 to "Yes and no" or "I don't know", -100 to "No", -300 to "Absolutely no", and the scores were averaged.

Note 2: Prepared based on the data stated in "A Public-Opinion Census of Science & Technology and Society" (surveyed in January, 1990 by Information Department, Prime Minister's Office).

2.4 Examinees' consciousness structure concerning their career selection

Multivariate analysis is used to extract essential factors irrespective of individual questions, for structurally identifying the consciousness of career selection and the views of science and technology. The results are described below. (For detailed analysis, see Appendix 4.)

(1) Consciousness structure in career selection

The factors for deciding the course to be selected can be classified into three major factors; "self-consciousness of natural science grounding" such as "like to theoretically pursue the principles and mechanisms of things" and "good at natural science-related subjects", "self-consciousness of non-NS&E grounding" such as "interested in the language and culture of any foreign country", "wish to think about human beings and life" and "interested in the mechanisms and movements of the society", and "consciousness to consider the university as a tool" such as "the university wished to enter is famous", "future life will be

affluent" and "advantageous for employment and promotion. Among the three major factors, "self-consciousness of natural science grounding" is the strongest. The "self-consciousness of NS&E grounding" and "self-consciousness of non-NS&E grounding" are factors for deciding the career selection between the NS&E course and the non-NS&E course.

On the other hand, the "consciousness to consider the university as a tool" is a factor for causing an individual department to be selected within the NS&E or non-NS&E course; the engineering-related department in the NS&E course and the law-, economics- or commercial science-related department in the non-NS&E course. The students who have been earlier decided their courses to select are clearer in their self-consciousness of NS&E grounding or non-NS&E grounding.

(2) What is expected for university life

The university life imagined by senior high school students has three aspects; "consumption-oriented university life" to enjoy the university life itself, "tool-oriented university life" to consider the university as a means for the future job, and "study-oriented university life" to pursue learning and knowledge. The emphasis laid on the respective aspects is different among students.

Generally, the intention to lead "consumption-oriented university life" does not depend so much on the departments selected, except that the intention is low in the students wishing to select the science-related department, and the consumption aspect of university life tends to be common to all departments. In other words, for today's young people, universities are, first of all, the places where they enjoy university life.

The inclination to consumption can be generally seen, but the students wishing to select the non-NS&E course show the tendency rather strongly. The students wishing to select the economics-, commercial science/business administration- and education-related departments are high in the intention to lead "tool-oriented university life". The "study-oriented university life" is strongly intended by the students wishing to select the science- and medical/dental-related departments.

(3) University life in the non-NS&E course and university life in the NS&E course (- Images of university life -)

The image items on the university life of non-NS&E course and NS&E course can be classified into two aspects; "image items concerned with the sense" such as "bright", "dark", "smart" and "awkward", and "image items concerned with diligence" such as "busy with studying", "not busy with studying", "diligent" and "idle". As is generally referred to, typical images of bright non-NS&E university life and hard working NS&E university life could be identified.

Thus, the images cherished by senior high school students about the university students of non-NS&E course and NS&E course are almost stereotyped. And yet, senior high school students wishing to select the non-NS&E course tend to think that the

university life of non-NS&E course is more diligent and harder than the high school students wishing to select the NS&E course do, and the high school students wishing to select the NS&E course tend to think that the university life of NS&E course is brighter than the high school students wishing to select the non-NS&E course do. Furthermore, comparatively, the students wishing to select the law-, and commercial science/business administration-related departments have a passive image on the university life of NS&E course.

(4) The structure of factors for job selection

The factors for job selection include three aspects; "affiliation merit" such as the scale, salary, name, stability, etc. of the employing enterprise, "sense of fulfillment through job" such as contribution to the society and use of knowledge, techniques and speciality, and "social aspect of job" such as communication with people, internationality and being able to work in an urban area. The senior high school students wishing to select the law-, economics-, commercial science/business administration- and engineering-related departments tend to give priority to "affiliation merit", and those wishing to select the science- and medical/dental-related departments tend to give priority to "sense of fulfillment through job", in their job selection.

Those who had once wished to select the non-NS&E course and changed their minds to select the NS&E course relatively give priority to the "sense of fulfillment through job". Those who wish to select the law-, economics- and commercial science/business administration-related departments and those who had once wished to select the NS&E course but changed their minds to select the non-NS&E course tend to give priority to the "social aspect of job". The image that the jobs concerned with science and technology are less sociable is surmised to be a factor to promote the change from the NS&E course to the non-NS&E course.

2.5 Examinees' consciousness structure concerning science and technology

The survey included not only the questions about the departments wished to be selected by examinees, but also those about the personalities indirectly affecting the career selection and the attitudes toward science and technology. These items are structurally analyzed, and the relation between the results and career selection is also analyzed.

(1) The structure of self-images such as natural science-oriented personality

As the self-images of senior high school students, four image factors of "natural science-oriented personality" such as mechanism mania and handicraft mania, "NS&E or non-NS&E study type", and "endurability" and "sociability" could be extracted. The "natural science-oriented personality" and "NS&E or non-NS&E study type" are identified under different factors. This sug-

gests that the existence of not a few persons who like mechanisms but are of non-NS&E type or who like handicraft but are of non-NS&E type. The courses wished to be selected are most closely related to "NS&E or non-NS&E study type", and next to "natural science-oriented personality". Many of the students who consider themselves to have "endurability" wish to select the medical/dental- and law-related departments, and many of those who consider themselves to have "sociability" wish to select the commercial science/business administration- or education-related department, or changed their career selection from the NS&E course to non-NS&E course.

(2) Young people's attitudes toward science and technology

Senior high school students' attitudes toward science and technology could be analyzed to extract two factors of interest; "interest in scientific and technological activities" as suggested by "interested in new trends of science and technology", "love to read newspaper articles of science and technology", etc., and "interest in the fruits of science and technology" as suggested by "it is good that traffic facilities become higher in speed.", "it is good that computers are developed to make life more convenient.", etc.

This indicates that the attitude toward science and technology cannot be considered under one concept. The interest in "scientific and technological activities" should be considered separately from the interest in the "fruits of science and technology". This means that there are persons who are highly interested in "scientific and technological activities" but less interested in the "fruits of science and technology", and, on the contrary, persons who are highly interested in the "fruits of science and technology" but less interested in "scientific and technological activities".

The students who wish to select the NS&E course, especially the science- and engineering-related departments are highly interested in "scientific and technological activities", and there is very clear correlation between the interest in "scientific and technological activities" and career selection. However, some students wishing to select the non-NS&E course are highly interested in the "fruits of science and technology", while others are not, and the correlation between the interest in the "fruits of science and technology" and career selection is not clear (Table 4).

The students wishing to select social science-related departments do not perfectly stay away from science and technology, but tend to be positive in utilizing the fruits of science and technology but not to be interested in the trends of science and technology. On the contrary, it is to be noted that those wishing to select the literature- and education-related departments are least interested in the trends of science and technology and are passive also in utilizing the fruits of science and technology.

Table 4 Relation between the attitudes toward science and technology and intended major

		Interest in the fruits of science and technology		
		High	Medium	Low
Interest in scientific & technological activities	High	Science- and engineering-related departments		
	Rather high		Medical/dental-related departments	
	Rather Low	Commercial science/ business administration-related departments	Law- & economics-related departments	
	Low			Literature- and education-related departments

2.6 Conclusions
- Functions of the information on scientific and technological activities, for young people's career selection -

In the above results, the following is important for tempting competent students to science and technology.

<1> Students' consciousness can be characteristically identified for each intended major.

The consciousness of university-minded students can be characteristically identified for each intended major.

For example, the students wishing to select the science- and engineering-related departments are weak in the subjects relating to the communication with people and society such as Japanese language, social studies and English language, among all the students wishing to select the NS&E course. Furthermore, these students tend to be passive on the items relating to the communication with people and society such as "communicating with people" and "reading and writing sentences". Thus, the students wishing to select the science- and engineering-related departments in general tend to be weak in presenting their information to the society. On the other hand, it is noted that among the students wishing to select the non-NS&E course, the students wishing to select the literature- and education-related departments which deliver many workers to the mass media and the education area who significantly affect young people in their career selection form a group least interested in science and technology.

<2> To increase the students wishing to select the science- and engineering-related departments, it is essential to enhance the interest in "scientific and technological activities".

In discussing the attitudes toward science and technology, it is necessary to carefully distinguish the interest in "scientific and technological activities" from the interest in the "fruits of science and technology". These two factors represent mutually independent consciousness tendencies, and in view of promoting the young people's selection of NS&E course, it is more important to enhance the interest in "scientific and technological activities" among the two factors.

<3> In the career selection between NS&E course and non-NS&E course, students who decide the career selection later in their school life select the non-NS&E course more.

The students who decide the career selection earlier select the NS&E course more, and on the contrary, those who decide later select the non-NS&E course more.

As for the reasons why the students who decide the career selection later select the non-NS&E course more, from the standpoint of students, there seem to be such factors as their consciousness of being weak in natural science-related subjects, and their desire to enjoy future affluent life and pleasant university life. Furthermore, in the society, workers who are surmised to relatively know scientists and engineers, such as managers, engineers and office workers tend to see scientists and engineers positioned lower in the society than the workers engaged in other jobs, and the jobs relating to science and technology provide an image of being low in sociability. Moreover, the university life of NS&E course give an image of being busy and dark. These factors seem to cause more students to select the non-NS&E course later in their school life.

<4> There is widespread consciousness among today's young people that the university is, first of all, a place to enjoy university life.

Among today's young people, there is widespread consciousness that the university is, first of all, "a place to enjoy university life". On the other hand, there are typical images of bright non-NS&E university life and busy NS&E university life. In this situation, it is feared that the university education of science- and engineering-departments becomes less attractive to young people.

The process of career selection in relation with the growth of young people has been discussed in reference to various factors affecting the selection. Now, the authors wish to propose a model as shown in Fig. 4, which simply and conceptually expresses the environment of young people in the flow of information of scientific and technological activities presented through households and society to young people.

This model assumes the following seven simplified items of media, by which the information of scientific and technological

activities is supplied to young people.

<1> Households
<2> Elementary and secondary education
<3> Mass media
<4> Business activities
<5> Universities
<6> Persons engaged in scientific and technological activities (scientists and engineers)
<7> Products produced by scientific and technological activities

The information of scientific and technological activities presented through these information media to Japanese young people is assumed to be respectively characterized as follows. These assumptions are not verified in a strict sense, but are highly probable judging from the actual situations, being expected to be able to contribute to the future planning of scientific and technological policies as references for guiding the discussion to take measures for preventing the currently highlighted young people's drift away from science and technology..

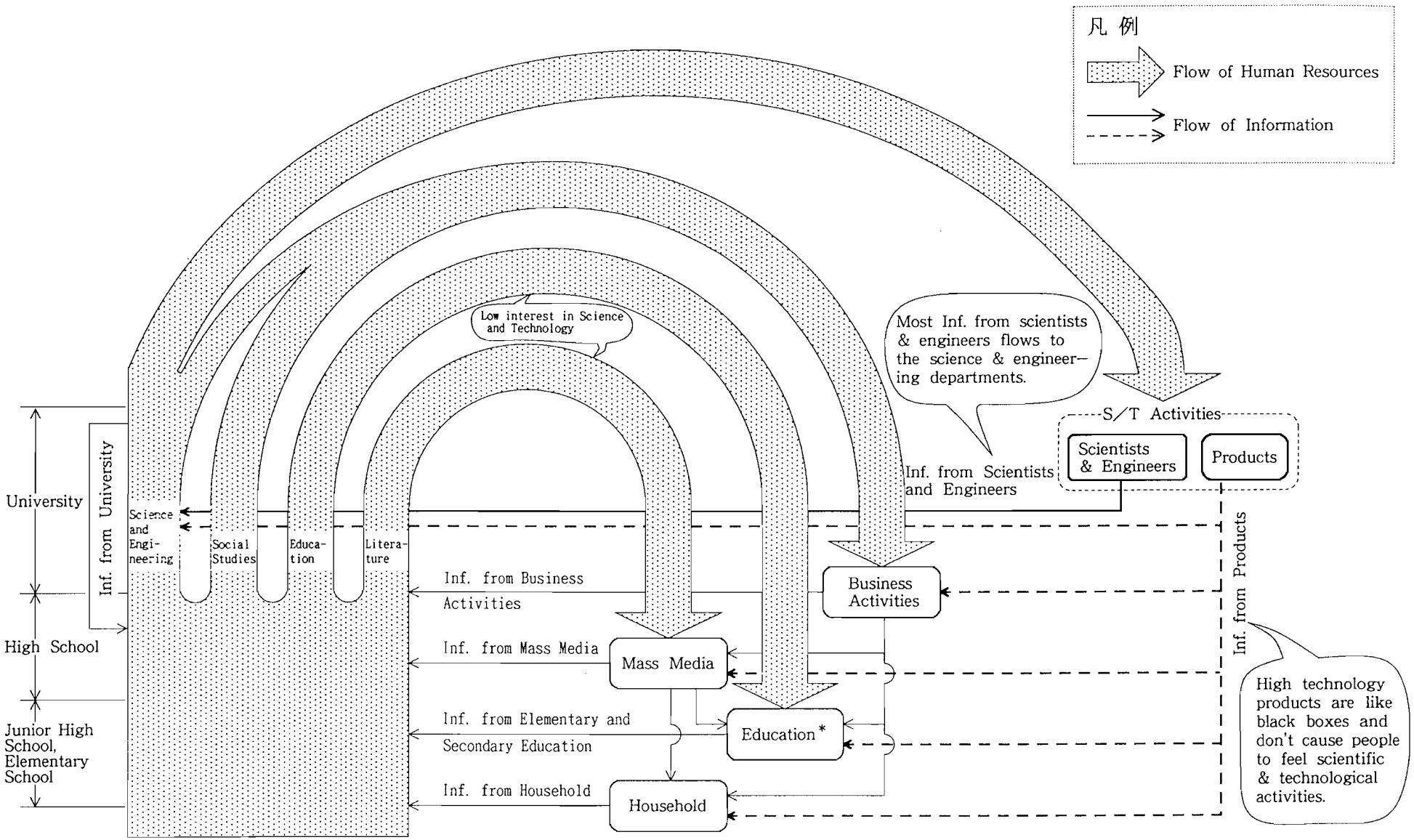
<1> Information given at households

The main sources of the information on scientific and technological activities now given to children at typical Japanese households must be the high technology products (television games, air conditioners, electronic ovens, remote control switches, multifunctional telephone sets, word processors, ...) themselves. These high technology products are not internally scrutinized, but exist simply like black boxes. If they get into troubles, most of them will be simply thrown away, without being repaired. In this situation, the "latest fruits of science and technology" must be felt as no more than matters of course. So, children can accept the "latest fruits of science and technology" without any resistance at all, but since science and technology is no more than matters of course, they may not feel the scientific and technological activities themselves near at hand in the actual society, and may be induced not to feel the benefits of scientific and technological activities or the impression involved in scientific and technological activities.

<2> Information given in elementary and secondary education

Partly being affected by the competition for entrance examinations, subjects relating to NS&E are mainly presented with emphasis placed on the efforts to solve given problems by calculation or memory. As a result, less efforts are made to grow the interest in scientific and technological activities by performing experiments or letting pupils and students learn the functions of science and technology in the actual society. (Similar arguments can be seen in References 4, 5, 6 and 7.)

Fig.4 Model of Information Flow on Youth's Career Selection and Science and Technology Activities



Note, * : Elementary and Secondary Education

In addition, the physics taught at the senior high school as an introduction to advanced education of science and engineering becomes difficult and less interesting due to the influence of entrance examinations to universities, and it is indicated that less senior high school students study physics. (See References 5, 8, 9 and 10.)

Furthermore, students wishing to select the education-related department which is a major supply source of teachers tend to be passive to science and technology, and it is feared that this tendency will be accelerated. (The necessity of improving the grounding and knowledge of students in the education-related department is pointed out also in Reference 5.)

<3> Information given from mass media

Young people have an established image of 3D (dangerous, difficult and dirty) on manufacturing and research activities, and on the other hand, widely share the longing for bright urban type and consumption type of youth culture. Such change of young people in consciousness must have been affected by mass media. The information supplied by mass media may implicitly make young people more interested in urban offices rather than local factories and consumption rather than production. For example, it seems that dramas and commercial messages present brilliant business activities in urban areas, and little show fields of manufacture and research. (Similar indications are given also in References 11, 12 and 13.)

Furthermore, publications which introduce researchers do not present many researcher images which young people wish to assume their future life. (Reference 14 is a typical case to emphasize researchers as ordinary persons, rather than researchers which young people wish to be.) In addition, as recently frequently reported, the information on the deteriorated research environment of universities and the information on the higher salaries gained in the financial industry than in the manufacturing industry lower the image of scientific and technological activities, making the situation more serious.

Moreover, the students wishing to select the literature-related department which is surmised to be a major supply source of future workers in mass media tend to be passive to science and technology, and it is feared that mass media will show further less interest in scientific and technological activities.

<4> Information given from business activities

Many of the businessmen acting in urban areas are doing their business through the contact with the people living outside their own world, and present much information to the society whether intentionally or unintentionally. However, the information given by them is mostly concerned with business men in their suits, and little concerned with scientists and engineers.

A public-opinion poll makes us presume that the people engaged in business activities in urban areas tend to consider the social position of scientists is lower than the positions of other groups of people, and they may present information to the

young people around them based on such impression.

<5> Information given from universities

University students may give stereotyped information that "the university is a place to enjoy university life in" and "bright non-NS&E university life vs. hard-working NS&E university life" based on their own experience.

<6> Information given from those engaged in scientific and technological activities (scientists and engineers)

The information presented by scientific and technological activities, i.e., manufacturing and research activities in the actual society to young people includes two types of information; the information presented by those engaged in scientific and technological activities (scientists and engineers) and the information presented through the products produced by scientific and technological activities. Since treating the latter as an independent information medium is easier for discussion, it will discussed later independently, and this section of the report discusses the former only.

Those engaged in scientific and technological activities in the actual society (scientists and engineers) are relatively less impressive to Japanese young people in general. When inventions, discoveries, etc. are taken up by mass media, the names of the companies or organizations concerned are introduced, and what people made such achievements and what they usually do are little reported. (Similar arguments are made in References 7 and 11.)

It can be presumed that the invisibility of jobs concerned with science and technology contributes to the formation of an image that the jobs concerned with science and technology are "unsociable".

In this situation, Japanese young people must be able to know what people are engaged in scientific and technological activities in the actual society only in very limited cases of seeing predecessors sometimes coming to visit their professors after their entrance into the science- and engineering-related departments of universities and of visiting laboratories of companies in their activities to select their jobs. In other words, those who did not select the science- and engineering-related departments of universities (a group which is relatively high in the ability to prevent information to the society, owing to their natures of being good at Japanese language and liking communication with people) go into the society without little knowing the people engaged in scientific and technological activities in the actual society, and less recognize the scientific and technological activities in the society.

The people engaged in manufacture and research in the actual society can be presumed to present the following information to the students of science- and engineering-related departments in universities unintentionally.

Jobs of engineers and researchers are special, closed, less extendible and monotonous (see References 15 and 16), and

these people are regarded as tools or gears by management (see Reference 11).

Engineers and researchers are not treated preciously in view of salary and social evaluation, compared to their contribution to the society (see Reference 11).

Furthermore, there is a widespread impression that scientists and engineers are poor talkers and are less interesting as persons (see References 11 and 17). Since many of the students wishing to select the science- and engineering-related departments which are the major supply sources of future scientists and engineers are weak in the subjects relating to communication in the human society such as Japanese language, social studies and English language, and passive in "communication with people" and "writing and reading sentences", it is feared that this tendency may be further accelerated in future.

<7> Information given from the products produced through scientific and technological activities

The information presented by scientific and technological activities to the society can be said to be presented mostly through the products purchased from stores for consumption, except the limited information given from scientists and engineers to the students of science- and engineering-related departments described in <6>. The scientific and technological activities seen through products present the consumers the images of organizations which produce the products, and do not present the general people the images of individuals engaged in the scientific and technological activities. Therefore, the image of science and technology which may attract young people cannot be seen.

Furthermore, since the products produced by scientific and technological activities are presented around us in very large quantities, it is feared that the situation in which "scientific and technological activities are not appreciated or impressive" pervades the society as a whole, as described for households in <1>.

From the results of discussion based on the model stated above, it can be seen that the basic problem in the distribution of information on scientific and technological activities in Japanese society is that the activities of scientists and engineers cannot be seen in the areas of households, elementary and secondary education, etc., since the scientists and engineers are poor in the ability to present their information to the society. The government should improve the information environment of scientific and technological activities around young people by taking the following measures in major efforts to complement the poor information presentability of scientists and engineers.

1) To intensify dissemination and enlightenment activities for passing the pleasure and excitement of scientific and technological activities in efforts to let household members to talk about scientific and technological activities more frequently.

2) To let elementary and high schools conduct experiments, etc. for stimulating the intellectual curiosity of boys and girls and making them easily understand and feel interesting the science taught, in support to enhance their interest in scientific and technological activities.

3) To systematically introduce the education on the functions of scientific and technological activities in the society, into school education, in efforts to enhance young people's interest in scientific and technological activities.

4) To positively present the information of scientific and technological activities to teachers and mass media.

5) To present information for making scientific and technological activities more visible.

6) To support scientists and engineers in their activities of expressing themselves.

7) To improve the lecture method in university education at science- and engineering-related departments, and to improve the buildings and equipment used by those departments, for erasing the image that the university life of science- and engineering-related departments is too busy and dark.

8) To drastically improve the treatment of scientists and engineers, for impressing people with the high social status of scientists and engineers in the actual society, in order that scientists and engineers may attract further attention of the society. (This measure is surmised to be necessary from the standpoint that the hardship such as busy studying felt in the university life in science- and engineering-related departments is sufficiently rewarded by the treatment in the actual society.)

The above measures include those discussed and suggested in the past by various circles (Reference 18, etc.). The above measures 3), 4), 5) and 6) which have been little discussed are described below.

3. Proposals on the presentation of the information on scientific and technological activities

3.1 Systematically introducing the education on the social functions of scientific and technological activities, into school education

To introduce engineering literacy education into the curricula of junior and senior high schools.

To introduce engineering literacy education into the liberal arts course

To construct a system in which field engineers positively participate in education.

To advocate the necessity for manufacturing and other industries to make their contribution.

To intensify the interest in the scientific and technological activities, the education on science and technology at schools must be enriched. The conventional education of science and technology has been provided through the education of natural science-related subjects at the elementary school to the senior high school and through the education of general education subjects relating to NS&E in the liberal arts course provided in the former half of university education. However, the science education lays its emphasis on the understanding of NS&E itself, and little refers to the functions of scientific and technological activities in the society. Science education itself must be improved to enhance young people's interest in scientific and technological activities, but since the science education (especially physics) at schools has already been variously discussed (References 2, 4, 5, 8, 9 and 10), this report proposes engineering literacy education from the viewpoint to promote the understanding on the functions of scientific and technological activities in the society.

The education in the engineering course at the senior high school and the education in the engineering-related department at the university are special education conducted for the special students who have selected the course concerned with science and technology. This education system has several drawbacks in the promotion of science and technology. The largest drawback is that unless students enter the engineering-related department at the university, they have little chance of engineering literacy education. Most young people become adults without facing engineering. This means that most of the society consists of people who little know engineering, i.e., how science and technology is applied in the real society, and our problem is that the information presented by the society affects the career selection of the next generation.

Engineering gives an insight as to the functions of scientific and technological activities in the society. In the present education system, partly because of entrance examinations for universities, subjects related to science and mathematics are apt

to be taught as independent subjects isolated from the relation with the society. Introducing basic engineering literacy education to complement the existing education system for letting people in various classes of the society understand more deeply the importance of the functions of scientific and technological activities in the society is surmised to be significant from the standpoint of promoting young people's career selection within scientific and technological areas.

Furthermore, few teachers engaged in the education up to the senior high school have graduated from the engineering-related department, except the teachers in the engineering course at the senior high school, and so few young people can communicate with teachers with engineering knowledge. Of course, the advice on career selection is given by teachers who do not know engineering. So, senior high school students must select their courses without knowing what is engineering, at all.

As suggested by the statement, "The science and technology and the view of nature in the 20th century have been developed first of all through engineering" (Reference 19), engineering is important for today's science and technology, but school education disregards engineering. Daily life is in the midst of various technological products resulting from engineering, but this is not sufficient. The interest in the fruits of science and technology is different from the interest in scientific and technological activities, as can be seen in Appendix 4. Unless the interest in scientific and technological activities is promoted, young people who are going to participate in scientific and technological activities will decrease sooner or later. As a result, it can be presumed that even if the fruits of science and technology fill the space around us, scientific and technological activities will begin to wane at their foundation (References 20 and 21).

Therefore, the system of school education must be examined first of all. Let's neglect the elementary school for the time being. Junior and senior high schools must give education on engineering. It will be effective to post engineering-educated teachers at senior high schools. In addition to engineering literacy education at junior and senior high schools, the general education course provided in the former half of university education must also include engineering literacy education. The term "engineering literacy education" was used in Reference 22 in the sense of the literacy required for responding to the society growing sophisticated in technology and artificial systematization (e.g., literacy on information processing), but this report uses this term in a wider sense to culture the ability to identify and discuss the outline and functions of scientific and technological activities in the society, and their relation with individuals' life. The education includes not only knowledge education but also field visits and practical training of engineering, as effective means for growing the interest in scientific and technological activities through actual experience. The reorganization of university education in general including the review of the relation between liberal arts education and special education is urgently required, and concurrently, the introduction of engineering literacy education must be achieved.

Furthermore, for the engineering literacy education up to the senior high school as well as at the university, the temporary adoption of field engineers and ex-engineers dispatched as lecturers from enterprises must be discussed. From the viewpoint to touch science and technology, the adoption of field engineers and ex-engineers dispatched from companies can be said to be more effective rather than the adoption of graduates from the engineering department as permanent teachers.

However, since commissioning only individual engineers to be engaged in engineering literacy education means to let them bear excessive burden, systematic support is required. Furthermore, to dispatch engineers to all the schools in Japan, a substantial organization is required. One method is proposed here to promote the engineering literacy education as part of social contribution of companies. In recent years, we hear such terms as enterprise philanthropy and enterprise Mecenat, and the cooperation of enterprises in education activities meet the spirit. If the dispatched engineers are paid by the dispatching companies, they can perform education activities as paid by their employers, and schools are not required to directly bear the expenses. For nationwide implementation, systematic coordination is required, and industrial economic organizations are recommended to be in charge of the coordination. The coordinating organizations perform coordination in the dispatch of engineers and execute such activities as the development of curriculum and the training of engineers to be dispatched, in cooperation with the parties concerned such as universities. Companies who do not dispatch engineers can contribute corresponding amounts of funds. The government must also support the activities. Promoting engineering literacy education under the cooperation of the industrial circles, academic circles and education circles under this scheme is a feasible measure.

3.2 Positively presenting the information on scientific and technological activities, to teachers and mass media

To arouse students' interest in scientific and technological activities through teachers' raised interest in scientific and technological activities.

To enhance the interest of teachers and mass media in scientific and technological activities.

In the stage of elementary and junior high schools, teachers have the largest power of influence on boys and girls. The fact that there are few teachers with engineering background suggests the necessity of any special consideration to be given for enhancing teachers' interest in scientific and technological activities. This is also suggested by the survey result shown in Appendix 1 that the students wishing to select the education-related department as future possible teachers are mostly weak in mathematics and science and tend to be less interested in the trends of science and technology.

Therefore, it is necessary to positively present high quality information of leading scientific and technological activities

to teachers in understandable and attractive ways, for enhancing teachers' interest in scientific and technological activities. Furthermore, the participation of field engineers in education may also enhance students' and also teachers' interest in scientific and technological activities.

On the other hand, in the education fields of elementary and junior high schools, as indicated also in the previous report, some educationalists point out the following problems:

> In recent years, people contact the nature less and feel seasonal changes less. They can see experiments on TV, to indirectly experience them before they are taught at schools. So, they are less interested in what are presented at schools and cannot be impressed by simple experiments. In this situation, the experiments and presentations performed at schools are required to be transformed to meet the current attitudes of boys and girls. In addition, teaching mainly resorts to textbooks, and uses less experiments.
>
> Many boys and girls have less ability of handicraft. For example, some cannot use even knives. Therefore, it is surmised to be effective to let the boys and girls in this growth stage actually contact "things" at every opportunity and to pass the great pleasure and excitement of creation involved in the activities of scientists and engineers to them, for arousing their strong interest in scientific and technological activities. Also for this purpose, it is surmised to be essential that field teachers themselves are highly interested in scientific and technological activities.

In the intensified information age of today, young people's attitudes toward science and technology are considered to be potentially significantly affected by the people engaged in mass media such as the press, broadcasting and newspapers. However, the information presented by the mass media is said to reflect the poor information presentability of scientists and engineers, and to emphasize the brilliance of urban business activities unconsciously, letting people less feel the existence of manufacturing and research sites (see References 11, 12 and 13). In this situation, presenting high quality information of leading scientific and technological activities to those engaged in mass media services in understandable and attractive ways is expected to be very effective in raising the interest of young people in scientific and technological activities in the long run.

For example, if manufacturers positively present the information of the process of development and production of new products such as what individuals made what efforts till the products had been commercialized, as well as the information on the results of the new products such as convenience and performance, then those engaged in mass media may be effectively induced to turn their eyes on the people working at manufacturing and research sites.

3.3 Making scientific and technological activities more visible

To grow competent persons who evaluate scientific and technological activities from outside and transfer the information to the general society, such as scientific and technological critics and journalists.

To work out and implement projects for raising the interest in scientific and technological activities.

The present analysis clarifies that the interest in the "fruits of science and technology" is different from the interest in "scientific and technological activities". Therefore, the fact that daily life is filled with the fruits of science and technology does not mean that the competent persons participating in scientific and technological activities can be secured. Essential is to raise the interest in scientific and technological activities themselves.

However, for various reasons, those engaged in scientific and technological activities are relatively poor in the ability to present their information. For example, it seldom happens that an engineer or a researcher in charge of manufacture appears as a hero in a TV drama (see Reference 10). Scientific and technological activities tend to exist invisibly in the general society. In addition, because of high speciality, scientific and technological activities are reviewed and introduced by scientists and engineers themselves (Reference 23).

In this situation, in order to enhance the recognition of scientific and technological activities in the society, it is required to make efforts to complement the poor information presentability of scientists and engineers by scientific and technological education in a broad sense, especially social education and enlightenment activities. First of all, efforts are required to make scientific and technological activities more visible to general people. In the enlightenment activities for science and technology, efforts will be required not only to present the fruits of science and technology, but also to positively introduce scientific and technological activities for passing their fun. This must be noted also in designing museums, etc. relating to science and technology.

To raise the interest of the general society in scientific and technological activities, scientific and technological critics and journalists who present the information on the activities to the general society are desired to be more active. The upbringing of competent critics and journalists for science and technology should also be promoted as the foundation for promotion of scientific and technological activities.

Furthermore, to enhance the interest in "scientific and technological activities", it can also be considered to work out and implement enlightening projects to give dreams and adventurous spirits to children. The challenge to the space is surmised to have such an effect. Though small in scale, robot competitions can also be significant.

Costly projects cannot always be good. Even though not useful directly, it will be necessary to promote projects which

will give dreams to children. As an immediate measure, what projects can be worked out and implemented should be studied.

Moreover, it is desirable that the books, magazines, etc. read by children take up topics which pass the excitement of scientific and technological activities and the pleasure of creation to them. Past surveys show a tendency that those who like reading and writing are inclined to select the non-NS&E course. However, it can happen that those who like reading and writing become scientists and engineers and that the non-NS&E course-oriented people who like reading and writing sentences are also interested in scientific and technological activities.

3.4 Changing the image of scientists and engineers - Let scientists and engineers talk about themselves and let the society support the action -

To let scientists and engineers talk about what they do at their job sites, in front of family members and other people around them, in efforts to make scientific and technological activities more visible, and to let the society support the action.

To improve the working environment and treatment of scientists and engineers, for making what scientists and engineers talk about more attractive.

To present an attractive model of scientists and engineers to the society.

The total number of scientists and engineers including university researchers is 2 million, accounting for 3% of labor force. This number suggests that what scientists and engineers do can be highly visible. And yet, what scientists and engineers do are not sufficiently understood by the society unnaturally.

The large number of scientists and engineers is an advantageous condition for making scientific and technological activities more visible. If all scientists and engineers inform what they do, first of all, to their own family members and furthermore other people around them, the activities will be effectively made visible. So, they should talk about what they do. The survey suggests that the decision to select the NS&E course is mostly made at the early stages. In this sense, the family and regional living environment exert significant influence on boys and girls, and it is meaningful that scientists and engineers talk with their family members and other people around them. The society should also support the action.

As described in 3.1, to dispatch field engineers as teachers for school education can be expected to be very effective in the sense that the chance for scientists and engineers to talk about themselves increases. If they are dispatched to their old schools, schools of their birthplaces, schools of their dwelling places or schools with any connection with them, their morale will be intensified, and the students who will be taught will get more interested in the lessons. The concrete implementation methods are desired to be variously contrived.

It will be an essential support to ensure that scientists and engineers who are positively going to talk with the society can proudly talk about what they do.

If what is talked about is not attractive, the desire to talk will fade, and what has been talked about gives no effect. Therefore, to improve the job sites and treatment of scientists and engineers is an essential condition for this activity. Especially since the young people just before taking the entrance examinations to universities or just after entering universities are greatly affected by job images in their career selection, planting a good image of scientists and engineers in the people of this age bracket is expected to be effective.

Furthermore, to support the activity indirectly, an attractive model of scientists and engineers must be presented to the society in efforts to enhance the prestige of these jobs. Concretely excellent scientists and engineers should be positively honored, and to let people know scientific and technological activities through the voices of scientists and engineers, many lecture meetings should be held including those with pupils and students as audiences. Moreover, television programs with scientists and engineers as hosts should be planned to efficiently give information to many people. These efforts should be made positively for support.

The organizations which survive and develop under the support provided by scientists and engineers should also positively present the information on scientists and engineers, to support the presentation of information by scientists and engineers. For example, when a manufacturer is going to launch a new product, they should positively present the information on individual scientists and engineers engaged in the R&D and manufacture, in addition to simply advertising the product and the company name. This is considered to be very effective in presenting an attractive model of scientists and engineers to the society.

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Note: Underlined references are translated into English and others are not.

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Appendices

Appendix 1

Images of examinees by intended major

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1. Purpose

In recent years, it is indicated that students of engineering- and science-related departments tend "to avert from the manufacturing industry" in their career selection, and some also indicate that more senior high school students tend to avert from the engineering- and science-related departments in their department selection for their entrance into universities.

If this tendency continues, it is feared that it may become difficult to secure competent persons important for future development of science and technology. To find hints for establishing policies for growing competent scientists and engineers, questionnairing was conducted on the senior high school students' consciousness of career selection and of science and technology in general, and the results were published as "Career selection by university-minded students" (NISTEP Report No. 12) in September, 1990.

Based on this report, it is intended to further analyze the basic summation results of the survey on the senior high school students' consciousness of career selection identified for respective departments wished to be selected, for clarifying what they are conscious of in their career selection.

2. Results of analysis

2.1 Senior high school students' career selection between natural science course and non-natural-science course

As stated in NISTEP Report No. 12, university-minded students were asked as to their career selection between the NS&E course and the non-NS&E course by making questions in the following three ways.

(1) School phase when you decided to select either NS&E course or non-NS&E course
(2) Course you belong to at senior high school
(3) Department, major you wish to select at university

From the replies to the respective questions made in the three ways of (1), (2) and (3), it was found that more than 40% of students wish to select the NS&E course and that more than 50% of students wish to select the non-NS&E course, and the replies to the three questions on the career selection between NS&E course and non-NS&E course were correlative to each other, as stated in NISTEP Report No. 12. Therefore, the replies to any of the questions can be referred to. The analysis on the selection

between NS&E course and non-NS&E course in this report uses the results of question (1) (those who selected replies, "certainly non-NS&E course" and "probably non-NS&E course" are considered to have selected the non-NS&E course when the question was made (autumn of third year at senior high school), and those who selected replies, "certainly NS&E course" and "probably NS&E course" are considered to have selected the NS&E course), and the analysis on the selection of departments uses the results of question (3) on the department or faculty wished to be selected at university.

Furthermore, as for the students who had wished to select the other course in the past (before the first term of second year at senior high school), those who had wished to select the non-NS&E course but changed their minds to select the NS&E course accounted for about 7% of those wishing to select the NS&E course (more than 40% of all the students), while those who had wished to select the NS&E course but changed their minds to select the non-NS&E course accounted for about 22% of those wishing to select the non-NS&E course (more than about 50% of all the students).

3. Factors relating to senior high school students' wish to select NS&E course or non-NS&E course

In reference to sexes, subjects they are good at or weak in, self-portrates, etc., the factors which relate to senior high school students' wish to select the NS&E course or the non-NS&E course were analyzed. The results were as follows.

3.1 By sex

With regard to the male-to-female ratio in the questionnairing, among all the university-minded students, males accounted for 64.2%, and females, 34.8%; among those wishing to select the NS&E course, males 76.5%, and females 22.4%; and among those wishing to select the non-NE&S course, males 53.5%, and females 45.7%.

In reference to the departments wished to be selected, females accounted for a very low rate among the students wishing to select the engineering-related department; 6.6%, compared to 92.1% of males. In the non-NS&E course, the females' rate was as low as 19.6% among the students wishing to select the economics-related department.

A females' rate of 65.7% was recorded among the students wishing to select the literature-related department, being followed by 60.5% among those wishing to select the education-related department. In the NS&E course, females wishing to select the medical/dental-related department account for a high rate of 36.4%.

3.2 Subjects which students are good at or weak in

Senior high school students wish to select the NS&E course or the non-NS&E course have close relation with the subjects they are good at or weak in. The subjects which the students wishing to select the non-NS&E course are good at agree to the subjects which the students wishing to select the NS&E course are weak in. Whether each student is good at or weak in each subject was asked in four steps (very good, rather good, rather weak and very weak).

As for the subjects they are (very and rather) good at, those wishing to select the NS&E course are mostly good at mathematics, chemistry and physics as expected, and on the contrary, those wishing to select the non-NS&E course are mostly good at Japanese language, social studies and English language.

On the contrary, as for the subjects they are (very and rather) weak in, the top three subjects in which those wishing to select the NS&E course are weak are Japanese language, English language and social studies, and the top three subjects for those wishing to select the non-NS&E course are
mathematics, chemistry and physics.

The respective subjects were given scores to express students' degrees of being good and weak for each department wished to be selected, and the differences of the averages for each department from the averages of all students are shown in Table 1.

In reference to the averages of all the students for respective subjects, social studies is the subject they are best at among all the subjects, being followed by Japanese language and English language. Physics is the subject they are weakest in, being followed by earth science, chemistry and mathematics. The fact that the subjects they are weak in as identified by averages of all the students include only those relating to NS&E course i.e., physics, earth science, chemistry and mathematics means that the present education methods, teaching materials, etc. at schools are designed to let students feel they are weak in the subjects relating to natural science, and this seems to further promote the students' drift away from the NS&E course.

[TABLE 1 ABOUT HERE]

(1) Analysis for respective departments wished to be selected

The students wishing to select respective departments can be characterized as follows:

[Science-related department]

Generally best at mathematics which is followed by chemistry and physics in this order.

Generally weakest in social studies which is followed by Japanese language and English language in this order.

[Engineering-related department]
Generally best at physics which is followed by mathematics and chemistry in this order.
Generally weakest in Japanese language which is followed by social studies and English language.

[Medical/dental-related department]
Generally best at biology which is followed by English language and chemistry in this order.
Generally weak in social studies compared to students wishing to select the other departments. However, there is no outstanding subject in which they are weak.

[Law-related department]
Generally best at social studies which is followed by Japanese language and English language in this order.
Generally weakest in physics which is followed by mathematics and chemistry in this order.

[Economics-related department]
Generally best at social studies.
Generally weakest in physics which is followed by chemistry.

[Commercial science/business administration-related department]
Generally best at social studies.
Generally weakest in physics and chemistry which are followed by earth science.

[Literature-related department]
Generally good at Japanese language which is followed by social studies.
Generally weakest in mathematics which is followed by physics and chemistry in this order.

[Education-related department]
Generally best at Japanese language.
Generally weakest in mathematics which is followed by physics and chemistry. The graduates from the education-related department are surmised to greatly affect pupils' and students' career selection and their likes and dislikes of subjects in their elementary and junior high school ages. Therefore, it should be considered as a serious problem that many of the graduates from the education-related department are conscious that they are weak in physics and chemistry.

(2) Analysis for respective subjects

How the students wishing to select respective departments are good at or weak in respective subjects are analyzed under respective subjects.

[Japanese language]
The group best at Japanese language is those wishing to select the literature-related department, and the group weakest in it are those wishing to select the engineering-department,

being followed by those wishing to select the science-related department.

If being good at Japanese language relates to the ability to present information, this tendency is surmised to mean that the graduates from the engineering- and science-related departments are insufficient in information presentability. In this case, it is feared that the career selection of the next generation is affected by the information presented by the other persons than these graduates, and as a result, that the number of the students wishing to select the NS&E course in the next generation is adversely affected.

[Mathematics]

The groups which are best at mathematics are those wishing to select the science- and engineering-related departments, and the groups which are weakest in it are those wishing to select the literature-, law- and education-related departments.

[English language]

The groups best at English language are those wishing to select the other departments in the non-NS&E course (including many students wishing to select the international science-related department), and the group weakest in it are those wishing to select the engineering-related department, the other departments in the natural science course, and the education- and science-related departments.

The tendency that those wishing to select the science-related department are weak in English language is considered as a problem to be improved, since one area in which Japan can contribute to the world is science and technology.

[Social studies]

The groups best at social studies are those wishing to select the law- and literature-related departments, and the groups weakest in it are those wishing to select the science-related department, the other departments in the NS&E course, and the engineering-related department.

If being good at or weak in social studies expresses the intensity of interest in the society, this tendency makes us fear that the graduates from the NS&E course will be less interested in the society in future. Their being less interested in the society is feared to mean their inability to explain what they do for science and technology, in relation with the society, and this may negatively affect the career selection by the next generation.

[Physics]

The groups best at physics are those wishing to select the science- and engineering-related departments, and the groups weakest in it are those wishing to select the literature- and commercial science/industrial administration-related departments, the other departments in the non-NS&E course, and the law-, education- and economics-related departments. The groups especially weak in physics compared to other subjects are those wishing to select the literature-, commercial science/business administration-, law-, education-, economics- and medical/dental-

related departments. It can be seen that consciousness of being weak in physics very widely pervades the senior high school students. This can be said to raise a question on the education of physics itself.

[Chemistry]
The groups best at chemistry are those wishing to select the science- and the medical/dental-related departments, and the groups weakest in it are those wishing to select the literature- and commercial science/business administration-related departments.

[Biology]
The group best at biology is those wishing to select the medical/dental-related department, and the group weakest in it is those wishing to select the literature-related department.

[Earth science]
The group best at earth science is those wishing to select the medical/dental-related department, and the groups weakest in it are those wishing to selected the commercial science/business administration- and literature-related departments.

3.3 Self-portrates

How the students are conscious of themselves (character, liking, etc.) is analyzed below in relation with the career selection between the NS&E course and the non-NS&E course.

As for the difference in the self-portrates of the students wishing to select the NS&E course and the non-NS&E course, many of those wishing to select the NS&E course like plastic models, mechanisms, personal computers, experiments and nature, and many of those wishing to select the non-NS&E course like the society and sentences. Among males, those wishing to select the non-NS&E course identify themselves in three patterns of "interested in social events", "like writing and reading sentences" and "am a non-natural-science-oriented person" more than those wishing to select the NS&E course.

On the contrary, those wishing to select the NS&E course identify themselves in five patterns of "know mechanisms well", "like making plastic models and handicraft", "like manipulating a personal computer, etc.", "like scientific experiments, etc.", and "am a natural science-oriented person" more than those wishing to select the non-NS&E course. However, among those wishing to select the NS&E course, those who had once wished to select the non-NS&E course less identify themselves as "am a natural-science-oriented person" than those consistently wishing to select the NS&E course, and more identify themselves as "am a non-natural-science-oriented person". Similar results are shown also by those wishing to select the non-NS&E course. Among females, similar tendencies as those of males can be seen, and in addition, females wishing to select the NS&E course further identify themselves as "like nature such as sea and mountains" and "like keeping living creatures". Such items as "like plastic models" and "like manipulating a personal computer" are selected

by females as few as less than one half of males among those wishing to select the NS&E course, but "like nature" and "like living creatures" are selected by more females than males among those wishing to select the NS&E course.

In reference to the departments wished to be selected, "know mechanisms well", "like making plastic models and handicraft" and "like manipulating a personal computer, etc." which are selected by many of those wishing to select the NS&E course are especially selected by those wishing to select the engineering-related department. As for "interested in social events" and "like writing and reading sentences selected by many of those wishing to select the non-NS&E course, the former is especially selected by those wishing to select the law-related department, and the latter is selected especially by those wishing to select the literature-related department.

As can be seen from Table 2, "like communication with people" and "like writing and reading sentences" as attributes relating to the liking and disliking of communication are selected least by those wishing to select the science- and engineering-related departments, and this makes us fear the future information presentability of the graduates from the science- and engineering-related departments who should play a large role for the career selection of the next generation.

[TABLE 2 ABOUT HERE]

4. Selection of departments and faculties of universities

What were referred to and what were given priority to when the senior high school students decided to select the respective departments and faculties of universities were questioned.

4.1 What were referred to in the selection of departments and faculties

Sixteen items were presented to students who were asked to specify the degree of each item in their reference out of four degrees (very decisive, significantly decisive, not so decisive, and not decisive at all). The results are almost the same irrespective of the courses selected. However, generally, those wishing to select the non-NS&E course seem to refer to external information more positively than those wishing to select the NS&E course.

In reference to the departments wished to be selected, a similar tendency can be observed. It is characteristic that many of those wishing to select the medical/dental-related department referred to "talking with a parent" and that many of those wishing to select the education-related department referred "talking with an elementary or junior high school teacher" and "talking with a senior high school teacher".

To examine the influence of adults on senior high school students, the departments selected by the students who referred to talking with senior acquaintances were examined (see Table 3).

[TABLE 3 ABOUT HERE]

As a result, it was found that the students who very or significantly decisively referred to the talking with a senior acquaintance tend to select the education-related department (1.27 in the value of D/B in Table 2), commercial science/business administration-related department (1.13), and medical/dental-related department (1.11), and on the contrary, tend to less select the engineering-related department (0.82) and science-related department (0.86).

This suggests that the adults with whom senior high school students consult for their career selection are generally not positive in recommending scientists and engineers as future positions.

4.2 What were given priority to in deciding departments and faculties

Under the question, "What did you give priority to when you decided the department, faculty or speciality of your desired university, short-term college or special college ?", students were presented 21 items and asked to specify the degree of each item out of five degrees ("gave high priority", "gave some priority", "Yes and no", "did not give so much priority" and "did not give priority at all").

In reference to the natural science course or non-NE&S course, the students wishing to select the NE&S course gave priority to such items as "wish to study leading matters of today" and "like making things and elaborate and steady performance" more than those wishing to select the non-NE&S course. On the contrary, those wishing to select the non-NE&S course gave priority to such items as "interested in social mechanisms and movements" and "very interested in the language and culture of any foreign country" more than those wishing to select the NE&S course.

The items given priority to by students for deciding their department selection are arranged in Table 4 for the respective departments wished to be selected.

[TABLE 4 ABOUT HERE]

The most common item given priority to is "Can study what I like", and this item is ranked at the top in many departments. It is conspicuous that "Wish to enjoy student life" is ranked at the top in the economics- and commercial science/business administration-related departments.

Furthermore, in reference to the respective departments wished to be selected, "wish to acquire a licence" is given high priority to by those wishing to select the medical/dental- and education-related department as can be expected. "Wish to enjoy student life" is generally given high priority to by those wishing to select the non-NS&E course, above all, those wishing to select the commercial science/business administration-related department. Those wishing to select the commercial science/busi-

ness administration-related department also characteristically gave high priority to "the university wished to be entered is located in an urban area" and "the university wished to be entered is famous".

Also among the items given priority to, an item relating to being good at or weak in any subject plays a key role for selection of departments and faculties.

5. Images cherished by senior high school students on university life

What images are cherished by senior high school students on the universities wished to be entered by them, and also on the university life they will lead there? It can be presumed that a future image affects the selection and life at present.

So, two questions were raised in this regard. One is "What are you going to give your priority to in your university life if you enter the university wished to be entered?". The other is "What image do you cherish for the student life of non-NS&E course and the university life of NS&E course?"

5.1 Priority given in university life

Under the question, "What are you going to give your priority to in your university life if you enter the university wished to by entered?", students were presented ten items of study, research, circle activity, etc. and asked to specify the degree of each item out of five degrees ("wish to give high priority", "wish to give some priority", "yes and no", "do not wish to give priority" and "do not wish to give priority at all"). In general, top four items were "relations with friends", "my hobby", "acquisition of licence" and "study or research".

In reference to the NS&E course or the non-NS&E course, it can be seen that those wishing to select the non-NS&E course imagine rosy university life, wishing to enjoy the relations with friends or heterosexual communication, circle activities, part-time job, travels, leisure and their own hobbies, rather than studying, while those wishing to select the NS&E course are prepared to devote their main efforts into studying rather than part-time job and leisure.

The top four items were analyzed in reference to the departments wished to be selected. The "relations with friends" was selected most by the students wishing to enter the education-related department which was followed by the economics-, law- and commercial science/business administration-related departments in this order. "My hobby" was selected most by those wishing to enter the law-related department which was followed by the engineering-, literature- and education-related departments in this order. "Acquisition of licence" was selected most by those wishing to enter the education- and medical/dental-related departments which were followed by the law- and commercial science/business administration-related departments in this order. "Study or research" was selected most by those wishing to select the medical/dental-related department which was followed by the science-, literature- and education-related departments.

5.2 Images of university life in natural science course and non-NE&S course

Under the question, "What images do you have on the university life at present universities?", the students were presented seven items such as "bright - dark", "dynamic - monotonous", etc. for the university life of NE&S course and non-NE&S course.

They have an image of being busy to study and being dark for the university life of NE&S course, and an image of not being busy to study and being bright for the university life of non-NE&S course.

Furthermore, the students wishing to select the non-NE&S course have more a favorable image for the university life of non-NE&S course than those wishing to select the NE&S course, and have a less favorable image for the university life of NE&S course.

In reference to the respective departments wished to be selected, those wishing to select the literature-related department are characteristic, and have an image on "advantageous - disadvantageous for employment" and "promising - unpromising" close to the image held by those wishing to select the NE&S course, rather than the image held by those wishing to select the other departments of non-NE&S course.

6. Job selection and job images of senior high school students

6.1 Items given priority to in job selection

In selecting jobs in future, senior high school students seem to give first priority to "do what I like" which is followed by "social stability" and "salary". However, about 90% of them give priority to "can use acquired knowledge and techniques", to suggest that senior high school students are interested in knowledge and techniques. The items given priority to by senior high school students in their job selection were analyzed in reference to NE&S course or non-NE&S course. Those wishing to select the NE&S course prefer "can be dedicated to one speciality", and those wishing to select the non-NE&S course prefer "less overworks and more holidays", "high chance of communicating with people", "can work internationally" and "can work in urban area". As for the items given priority to in job selection, those wishing to select the NE&S course tend to mind speciality, as can be seen in their preference of "can be dedicated to one speciality".

The items "given high priority to" by 30% or more of students for their job selection are enumerated in Table 4 for the respective departments wished to be selected. As can be seen from the table, what are given priority to irrespective of the departments are "can do what I like" and "high stability". In general, "can do what I can" is given the highest priority to, but for the economics- and commercial science/business administration-related departments, "high stability" is also similarly given priority to characteristically.

For the science-, engineering-related and medical/dental-related departments, "can use knowledge, etc." is given high priority, to suggest students are conscious to use what they

learn at university, also in their jobs, but for the economics- and commercial science/business administration-related departments, "good salary" and "less overworks and more holidays" are given priority to, to suggest they are conscious of general merits they will enjoy in relation with their jobs.

Features of respective items are introduced below.

[Large company]

The group which gave the highest priority to this item was the students wishing to select the commercial science/business administration-related department (given high priority to by 31.3% of students) which was followed by the economics-related department (30.9%). (Those wishing to select the engineering-related department (29.4%) in the NE&S course) The group which gave the lowest priority to this item was those wishing to select the literature-related department (11.8%) which was followed by the education-related department (12.7%). (Those wishing to select the science-related department (14.6%) in the NE&S course)

[Good salary]

The group which gave the highest priority to this item was those wishing to select the economics-related department (53.9%) which was followed by the commercial science/business administration-related department (53.2%) and the law-related department (51.8%). (Those wishing to select the engineering-related department (49.6%) in the NE&S course)

The group which gave the lowest priority to this item was those wishing to select the science-related department (28.2%) which was followed by the educaiton-related department (29.7%).

[TABLE 5 ABOUT HERE]

[Less overworks and more holidays]

The group which gave the highest priority to this item was those wishing to select the commercial science/business administration-related department (40.3%) which was followed by the economics-related department (38.7%) and the law-related department (38.4%).

The group which gave the lowest priority to this item was those wishing to select the medical/dental-related department (22.2%) which was followed by the education-related department (23.5%).

[High possibility of success]

The group which gave the highest priority to this item was those wishing to select the commercial science/business administration-related department (32.3%) which was followed by the law-related department (30.8%) and the economics-related department (28.6%). (Those wishing to select the engineering-related department (26.5%) in the NE&S course.)

The group which gave the lowest priority to this item was those wishing to select the literature-related department (10.4%) which was followed by the education-related department (12.1%) and the science-related department (13.9%).

[High stability]

The group which gave the highest priority to this item was those wishing to select the commercial science/business administration-related department (63.7%) which was followed by the law-related department (60.9%) and the economics-related department (58.5%).

The group which gave the lowest priority to this item was those wishing to select the science-related department (42.5%).

[Can contribute to the world]

The group which gave the highest priority to this item was those wishing to select the medical/dental-related department (56.7%) which was followed by the law-related department (33.4%) and the education-related department (33.0%).

The group which gave the lowest priority to this item was those wishing to select the commercial science/business administration-related department (16.4%) which was followed by the economics-related department (19.8%), the science-related department (22.9%) and the engineering-related department (23.1%).

[Can use knowledge, etc.]

The group which gave the highest priority to this item was those wishing to select the medical/dental-related department (64.7%) which was followed by the science-related department (61.8%). (Those wishing to select the literature-related department (50.5%) in the non-NE&S course.)

The group which gave the lowest priority to this item was those wishing to select the economics-related department (28.4%) which was followed by the commercial science/business administration-related department (37.8%).

[Can be dedicated to one speciality]

The group which gave the highest priority to this item was those wishing to select the science-related department (47.9%) which was followed by the medical/dental-related department (46.5%).

The group which gave the lowest priority to this item was those wishing to select the economics-related department (16.8%) which was followed by the commercial science/business administration-related department (17.9%).

[Can do what I like]

The group which gave the highest priority to this item was those wishing to select the science-related department (76.4%) which was followed by the literature-related department (74.7%).

The group which gave the lowest priority to this item was those wishing to select the economics-related department (58.0%) which was followed by the commercial science/business administration-related department (63.7%).

6.2 Job categories wished to be selected

As for the jobs wished to be selected in future, the students wishing to select the NE&S course mostly wish to select medical services, scientific professionals, and mechanical and electrical engineers, and those wishing to select the non-NE&S course mostly wish to select educational services and public officers.

In reference to the respective departments wished to be selected, those wishing to select the science-related department wish to select scientific professionals (concerned with science and technology); those wishing to select the engineering-related department, mechanical and electrical engineers; and those wishing to select the medical/dental-related department, medical services. As regards the students wishing to select the non-NE&S course, those wishing to select the law-related department mostly wish to select judicial services, public officers, public corporations, etc.; those wishing to select the economics- and commercial science/business administration-related departments, business professionals concerned with financial and distribution services; those wishing to select the literature-related department, mass media; and those wishing to select the education-related department, educational services.

6.3 Images of jobs

Jobs concerned with NE&S such as engineers and scientists are imagined to be "creative", "dynamic", etc., i.e., attractive in view of work done, but to be poor in view of practical benefit such as "stability" and "salary".

On the other hand, large bank clerks are imagined to be "monotonous" and "non-creative", i.e., poor in view of work done, but to be attractive in view of practical benefit such as "stability" and "salary".

Irrespective of the departments wished to be selected, images similar to the above are cherished and no difference can be observed.

7. Senior high school students' views on science and technology

Senior high school students' attitudes toward "science" and "technology" are complicated. While they wish to utilize the results of science and technology in their life, they seem to be highly interested in scientists' responsibilities and the influence of science and technology on people.

Meanwhile, about 50% of students replied "yes and no" or "don't know" to the items, "the progress of science and technology makes people happy." and "Japan should spend more efforts for the development of science and technology.", to show that their attitudes toward science and technology are partially skeptical. The students wishing to select the natural science course are highly conscious of science and technology since they highly evaluate, (A)"it is good that traffic means become higher in speed.", (B) "I wish to positively use the results of science and

technology.", (C)"it is good that computers are developed to make life more convenient.", (D)"I am interested in the new trends of science and technology.", (E)"I love to read newspaper articles, etc. on science and technology.", (F)"Japan should spend more efforts for the development of science and technology.", (G)"I wish to be engaged in any job concerned with science and technology in future.", etc. Especially for three items of (D),(E) and (G), there is a large difference between those wishing to select the NE&S course and those wishing to select the non-NE&S course. Among the students wishing to select the NE&S course, those wishing to select the science- and engineering-related departments are highly conscious of science and technology.

Among the attitudes toward science and technology, the items evaluated very differently among the students wishing to select respective departments are given marks in Table 6.

[TABLE 6 ABOUT HERE]

7.1 Analysis of respective attitudes

The attitude, "I love to read newspaper articles, etc. on science and technology, compared to others." can be regarded as an indicator of how far the answerer is interested in the latest trends of science and technology and the underlying principles and mechanisms. The group which showed this attitude most remarkably was those wishing to select the science-related department which was followed by the engineering-related department. The group which showed this attitude least was those wishing to select the "other departments in the non-ne&s course" which was followed by the education- and literature-related departments in this order.

The attitude, "I am interested in the new trends of science and technology such as 'superconductivity' and 'biotechnology'" can be considered to express how far the answerer is interested in the trends of technological innovation affecting our society. The groups which showed this attitude remarkably were those wishing to select the science- and engineering-related departments, and the group which showed this attitude least was those wishing to select the education-related department which was followed by the "other departments in the non-NE&S course" and the literature-related department in this order.

The attitude, "I wish to positively use the latest results of science and technology such as personal computer." can be considered to express how positive the answerer is in introducing the latest results of science and technology into his life.

This attitude was most remarkably shown by those wishing to select the engineering-related department which was followed by the science-related department. Among those wishing to select the non-NE&S course, those wishing to select the commercial science/business administration-related department showed this attitude.

On the contrary, this attitude was least shown by those wishing to select the education-related department which was followed by the literature-related department.

The attitudes, "It is good that traffic means become higher

in speed due to the development of linear motor car, etc." and "It is good that computers are developed to make life more convenient." can be considered as indicators to show how flexibly the answerer can accept the latest results of science and technology in the entire society around him.

The groups which were most flexible in this attitude were those wishing to select the engineering- and commercial science/ business administration-related departments which were followed by the science-, law- and medical/dental-related departments. The group which was least flexible was those wishing to select the literature-related department which was followed by the education-related department.

The comment, "The progress of science and technology makes people happy." means to admit that the process of science and technology favorably affects the society. Few students agreed to this comment, but the difference in intensity among the students wishing to select the respective departments shows almost the same tendency as in their responses to the flexibility to the results of science and technology.

The comment, "Science and technology is no more than a means, and the world is moved by the people engaged in politics and economics." can be considered to express how the answerer evaluates the role of science and technology in reforming the society.

The group most positive in this regard was those wishing to select the "other departments of natural science course" which was followed by the science-related department, and the groups which least evaluated the role of scientists and engineers in moving the society were those wishing to select the law-, economics- and commercial science/business administration-related departments.

The comment, "Japan should spend more efforts for the development of science and technology." can be considered to express how the answerer evaluates the social necessity for the progress of science and technology.

This is evaluated highest by those wishing to select the engineering-related department which was followed by the science-related department.

The group most skeptical of the necessity of the progress of science and technology was those wishing to select the "other departments of non-NE&S course" which was followed by the education- and literature-related departments.

7.2 Analysis for respective departments wished to be selected

The attitudes toward and comments on science and technology are analyzed below in reference to the respective departments wished to be selected.

[Students wishing to select the science-related department]

This group is highest in the interest in the principles and mechanisms of science and technology and the trends of technological innovation.

They are second most positive in introducing the latest results of science and technology into their life, next to those wishing to select the engineering-related department, but tend to be less positive in introducing the results into the society not only than those wishing to select the engineering-related department but also those wishing to select the commercial science/business administration-related department.

They mostly highly evaluate the role of scientists and engineers in moving the society and positively recognize the necessity of the progress of science and technology.

[Students wishing to select the engineering-related department]

This group is second highest in the interest in the principles and mechanisms of science and technology and the trends of technological innovation, next to those wishing to select the science-related department.

They are most positive in introducing the latest results of science and technology into their life, and most flexible in accepting the results into the entire society.

However, they tend to be somewhat skeptical of the ability of scientists and engineers in moving the society.

The necessity of the progress of science and technology is recognized most by this group.

[Students wishing to select the medical/dental-related department]

This group is generally positive for science and technology, but is lower in the flexibility to accept the results of science and technology into the society than those wishing to select the commercial science/business administration- and economics-related departments.

[Students wishing to select the law-related department]

The attitude toward science and technology is passive, though not so passive as those wishing to select the education- and literature-related departments.

Especially, they are negative on the ability of scientists and engineers in moving the society.

[Students wishing to select the economics- and commercial science/business administration-related departments]

These groups are low in the interest in the principles and mechanisms of science and technology but rather high in the interest in the trends of technological innovation though not so high as those wishing to select the science-related department.

They are rather positive also in introducing the latest results of science and technology into their life, and also very high in the flexibility to accept the results into the entire society.

The social necessity of the progress of science and technology is rather positively recognized by them, but the role of scientists and engineers in moving the society is negatively evaluated.

[Students wishing to select the literature-releated department]

This group is the second lowest in the interest in science and technology, next to those wishing to select the education-related department.

They are the second most passive also in introducing the latest results of science and technology into their life, next to those wishing to select the education-related department, and lowest in the flexibility to accept the introduction of the results into the entire society.

They are rather negative on the role of scientists and engineers in moving the society.

The necessity of the progress of science and technology is recognized third least, next to those wishing to select the other departments of non-NE&S course and the education-related department.

[Students wishing to select the education-related department]

This group is the least interested in science and technology, and most passive in introducing the latest results of science and technology into their life.

They are the second most passive in introducing the latest results of science and technology into the entire society, next to those wishing to select the literature-related department.

The role of scientists and engineers in moving the society is recognized to be rather negative.

The necessity of the progress of science and technology is considered the second most negatively, next to those wishing to the other departments of non-NE&S course.

8. Conclusions

The above suggests the following:

<1> Several signs which threaten to negatively influence the next generation's career selection can be seen.

The students wishing to select the science- and engineering-related departments are not so positive in presenting information to the society.

The students wishing to select the education-related department who are surmised to significantly affect the career selection of elementary school pupils and junior high school students (next generation) tend to have very negative attitude toward science and technology.

The students wishing to select the literature-related department who are mostly expected to be engaged in mass-media or work as writers, to influence the formation of next generation's social trends tend to have very negative attitude toward science and technology.

<2> Adults who are liable to be approached by senior high school students for deciding their career selection do not seem to consider engineering or science as a recommendable course.

<3> The conspicuously characteristic attitudes of those wishing to select the science- and engineering-related departments are their high interest in science and technology and their recognition on the social significance of the progress of science and technology.

The flexibility in accepting the use of the results of science technology is high among those wishing to select the commercial science/business administration- and economics-related departments, and cannot be considered as a decisive factor for selection of NE&S course.

<4> Very many senior high school students think they are weak in physics. So, the present education method must be drastically improved anyway. Since many of senior high students good at physics wish to select the science- and engineering-related departments, the improvement of physics education is expected to increase the students wishing to select these departments.

Table 1 Subjects which students are good at or weak in by intended major

Dept. selected / Subject	Natural science			Non-natural science					Average of all
	Science	Engi-neering	Medical/dental	Law	Economics	Comm/admin.	Litera-ture	Edu-cation	
Jap.lang.	-34.9	-68.1	- 7.7	46.0	- 5.6	5.8	87.0	39.4	-24.6
Math.	72.1	62.5	31.0	-40.5	- 9.1	- 0.6	-78.3	-25.8	-37.6
Eng.lang.	-17.5	-31.1	36.6	28.7	0.5	-10.9	8.8	-17.2	-35.9
Social	-38.0	-31.6	-17.4	68.4	15.9	20.8	41.1	- 0.5	- 8.1
Physics.	64.4	66.4	26.8	-44.0	-48.2	-56.0	-69.7	-53.2	-86.9
Chemistry	67.0	40.0	49.7	-20.0	-47.9	-56.6	-59.1	-50.6	-58.3
Biology	27.5	-28.0	57.2	1.9	-12.1	-14.5	-13.0	16.0	-49.6
Earth	29.2	9.5	22.4	10.2	- 9.7	-30.3	-12.6	-16.5	-85.5

Note: The following scores were given for respective subjects: "Very good" +200, "Rather good" +100, "Rather weak" -100 and "Very weak" -200.

Table 2 Ranking of respective departments wished to be selected, for attributes relating to the liking and disliking of communication

Ranking	Like communication with people		Like writing and reading sentences	
1	Education	(28.9)	Literature	(105.6)
2	Comm./admin.	(17.8)	Law	(34.9)
3	Economics	(11.4)	Education	(16.8)
4	Medical/dental	(3.3)	Medical/dental	(4.0)
5	Law	(2.7)	Comm./admin.	(- 13.5)
6	Engineering	(- 8.4)	Science	(- 19.1)
7	Literature	(-22.0)	Economics	(- 20.0)
8	Science	(-38.2)	Engineering	(- 57.0)

Note: Replies for each attribute question were evaluated as +200 for "Yes, indeed", +100 "Yes, partly", -100 "No, rather" and -200 "No, at all", and the difference between the average of each department and the average of all students was stated in the parentheses.

Table 3 Departments selected by the students who replied the talking with senior acquaintances was "very decisive" and "significantly decisive"

Department wished to be selected	A	B=A/3,858 (%)	C	D=C/1,414 (%)	D/B
Science	280	7.3	89	6.3	0.86
Engineering	793	20.6	238	16.8	0.82
Medical/dental	275	7.1	111	7.9	1.11
Others	362	9.4	140	9.9	1.05
Sub-total	1,710	44.3	578	40.9	0.92
Law	419	10.9	134	9.5	0.87
Economics	388	10.1	140	9.9	0.98
Comm./admin.	201	5.2	84	5.9	1.13
Literature	289	7.5	98	6.9	0.92
Education	306	7.9	142	10.0	1.27
Others	545	14.1	238	16.8	1.19
Sub-total	2,148	55.7	836	59.1	1.06
Total	3,858	100.0	1,414	100.0	----

A = Number of answering university-minded students
B = Rate to total of answerers
C = Number of students who decisively referred to senior acquaintance*
D = Rate to total of referring students
D/B = Ratio of the respective rates

Note: * Number of students who replied the reference to the talking with a senior acquaintance was "very decisive" and "significantly decisive".

Table 4 Items given priority to by students when deciding their department selection (Items which were "given high priority to" by 30% or more of students for each department are enumerated.)

A. Natural science course	B. Non-natural-science course
[Science-related department] <1> Can study what I like. (61.4%) <2> Like to theoretically pursue principles, mechanisms of things, etc. (43.6%) <3> Interested in natural phenomena and organisms. (40.7%) <4> Wish to study leading matters of today. (36.8%) <5> Good at subjects relating to natural science. (30.7%) <6> Wish to enjoy student life. (30.4%) [Engineering-related department] <1> Can study what I like. (45.6%) <2> Wish to study leading matters of today. (40.9%) <3> Like making things and elaborate and steady performance. (33.8%) <4> Wish to enjoy student life. (33.2%) [Medical/dental-related department] <1> Can study what I like. (50.9%) <2> Wish to acquire a licence. (48.7%) <3> Wish to enjoy student life.	[Law-related department] <1> Can study what I like. (48.7%) and movements. (47.3%) <2> Interested in social mechanisms <3> Wish to enjoy student life. (43.7%) <4> Wish to acquire a licence. (30.3%) [Economics-related department] <1> Wish to enjoy student life. (44.8%) <2> Interested in social mechanisms and movements. (34.5%) [Commercial science/business administration-related department] <1> Wish to enjoy student life. (52.7%) <2> Interested in social mechanisms and movements. (34.3%) <3> Can study what I like. (33.3%) <3> Advantageous for employment and promotion after employment. (33.3%) <5> Wish to acquire a licence. (30.8%) <6> Number of examination subjects of the university wished to be entered. (30.3%) <7> The university wished to be (30.5%) entered is famous. (30.3%) [Literature-related department] <1> Can study what I like. (65.1%) <2> Wish to enjoy student life. (36.3%) <3> Wish to think about human beings and life. (36.0%) [Education-related department] <1> Can study what I like. (48.0%) <2> Wish to acquire a licence. (45.8%) <3> Wish to enjoy student life. (42.8%)

Note: Each parenthesized numeral is the rate of the students who replied "gave high priority".

Table 5 Items given priority to for job selection (items "given high priority to" by 30% or more of students for each department wished to be selected are enumerated)

A. Natural-science	B. Non-Natural-science
[Science-related department]	[Law-related department]
<1> Can do what I like.(76.4%)	<1> Can do what I like.(69.7%)
<2> Can use knowledge, etc.(61.8%)	<2> High stability.(60.95)
<3> Can be dedicated to one speciality.(47.9%)	<3> Good salary.(51.8%)
<4> High stability.(42.5%)	<4> Can use knowledge, etc.(46.1%)
[Engineering-related department]	<5> Less overwork and more holidays. (38.4%)
<1> Can do what I like.(70.1%)	<6> Can contribute to the world. (33.4%)
<2> Can use knowledge, etc.(52.0%)	<7> Can work internationally.(31.5%)
<3> High stability.(51.3%)	<8> High possibility of success. (30.8%)
<4> Good salary.(49.6%)	[Economics-related department]
<5> Can be dedicated to one speciality.(36.3%)	<1> High stability.(58.5%)
[Medical/dental-related department]	<2> Can do what I like.(58.0%)
<1> Can do what I like.(73.1%)	<3> Good salary.(53.9%)
<2> Can use knowledge, etc.(64.75)	<4> Less overwork and more holidays. (38.7%)
<3> Can contribute to the world. (56.7%)	<5> Large company.(30.9%)
<4> High stability.(48.4%)	[Commercial science/business administration-related department]
<5> Can be dedicated to one speciality.(46.5%)	<1> High stability.(63.7%)
<6> Good salary.(34.2%)	<1> Can do what I like.(63.7%)
	<3> Good salary.(53.2%)
	<4> Less overwork and more holidays. (40.3%)
	<5> Can use knowledge, etc.(37.8%)
	<6> High possibility of success. (32.3%)
	<7> Large company.(31.3%)
	<8> Can work internationally.(30.8%)
	[Literature-related department]
	<1> Can do what I like.(74.7%)
	<2> Can use knowledge, etc.(50.5%)
	<3> High stability.(47.8%)
	<4> Can be dedicated to one speciality.(32.5%)
	<5> Good salary.(31.1%)
	[Education-related department]
	<1> Can do what I like.(69.0%)
	<2> High stability.(56.2%)
	<3> Can use knowledge, etc.(48.4%)
	<4> Can contribute to the world.(33.0%)
	<5> Can communicate with people.(30.7%)

Note: Each parenthesized numeral is the rate of students who answered "gave high priority"

Table 6 Attitudes toward and comments on science and technology, differently evaluated by the students wishing to select respective departments

Attitude toward or comment on science and technology	Natural science course				non-natural-science course					
	Sci.	Engi.	Med/den.	Other	Law	Econ.	Com/adm.	Liter.	Educ.	Other
I love to read newspaper articles, etc. on science and technology, compared to others.	① 41.8	② 32.4	③ 25.8	④ 16.3	⑤ -7.0	⑥ -11.6	⑦ -16.4	⑧ -22.5	⑨ -29.1	⑩ -30.1
I am interested in new trends of science and technology such as "superconductivity" and "biotechnology".	① 57.1	② 55.0	④ 38.6	③ 41.5	⑦ -6.4	⑥ -3.1	⑤ 2.5	⑧ -16.2	⑩ -19.9	⑨ -18.2
I wish to positively use the latest results of science and technology such as personal computer.	② 50.7	① 55.6	④ 36.0	③ 44.5	⑦ 16.3	⑥ 22.6	⑤ 30.4	⑨ 4.1	⑩ 2.9	⑧ 8.0
It is good that traffic means become higherin speed due to the development of linear motor car, etc.	④ 31.8	② 41.6	⑥ 24.8	⑦ 24.0	⑤ 28.4	③ 36.1	① 42.3	⑩ -0.4	⑨ 17.7	⑧ 18.2
It is good that computers are developed to make life more convenient.	③ 30.0	① 39.7	⑥ 18.9	④ 26.5	⑦ 17.9	⑤ 26.3	② 32.4	⑩ -3.2	⑨ 4.0	⑧ 11.6
The progress of science and technology makes people happy.	② -6.5	① 0.0	⑥ -18.6	⑤ -15.4	⑦ -21.7	④ -12.1	③ -10.5	⑩ -31.5	⑧ -21.9	⑨ -29.0
Science and technology is no more than a means. The world is moved by the people engaged in politics and economics	② -16.4	④ -3.9	③ -8.3	① -18.5	⑨ 15.5	⑨ 15.5	⑧ 13.9	⑥ 4.8	⑦ 8.5	⑤ 4.0
Japan should spend more efforts for the development of science and technology.	② 29.0	① 37.8	③ 19.6	④ 19.1	⑦ 3.6	⑥ 7.2	⑤ 7.5	⑧ -4.2	⑨ -4.5	⑩ -7.3

Note: Each attitude or comment was given +100 scores for each "Yes", and -100 scores for each "No", and the total value was averaged for each department. The circled numerals indicate the ranking for each attitude or comment.

Appendix 2

Senior high school students' consciousness of career selection in relation with school phases the intended major has been decided

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1. Purpose

The authors indicated in NISTEP Report No. 12 that the students wishing to select the non-NS&E course tend to be later in the timing to decide their career selection than those wishing to select the NS&E course. This suggests that there may be any relation between the timing to decide career selection and the courses wished to be selected. To search for the factors concerned with the relation, the authors compared the attributes of those wishing to select the NS&E course and the non-NS&E course in reference to the school phases when the career to be selected was decided, based on the data of Basic Summation Table III of Appendix 5.

This report introduces the results, and compiles the implications suggested by them for science and technology policy making.

2. School phases when the intended major has been decided

The students who "have definitely decided to select the non-NS&E course" and "have almost decided to select the non-NS&E course" at the time of questionnairing (2nd term of third year at senior high school) were identified as the students wishing to select the non-NS&E course, and the students who "have definitely decided to select the NS&E course" and "have almost decided to select the NS&E course" were identified as the students wishing to select the NS&E course.

If a student wishing to select the non-NS&E course had "definitely" or "almost" decided to select the non-NS&E course "about 5th to 6th year at elementary school" and had "definitely" or "almost decided to select the non-NS&E course "about 2nd year at junior high school" and also "about 1st term of 2nd year at senior high school", then it can be presumed that he decided his career selection before 5th to 6th year old at elementary school.

In this way, from the results of the questionnairing, the school phases when the respective answerers decided their career selection were arranged as shown in Table 1.

[TABLE 1 ABOUT HERE]

From Table 1, the following tendencies can be identified:
<1> The later the school phase when the career to be selected, the more students wish to select the non-NS&E course.
<2> The number of the students who had once wished to select the NS&E course but changed their minds to select the non-NS&E course

is very larger than the number of the students who behaved in the other way.

The students who had wished to select the NS&E course at about 1st term of 2nd year at senior high school but changed their minds to select the non-NS&E course by 2nd term of 3rd year at senior high school accounted for 11.9% [= (370 persons x 54.0%)/(3,731 persons x 45.1%)], but the students who behaved in the other way accounted for only 2.1% [= (156 persons x 23.1%)/(3,731 persons x 45.4%)].

Furthermore, 22.0% [= 452 persons/2,058 persons] of the students wishing to select the non-NS&E course had once wished to select the NS&E course, while only 7.2% [= 120 persons/1,673 persons] of the students wishing to select the NS&E course had once wished to select the non-NS&E course.

3. School phases when the intended major has been decided, and attributes of students

(1) The existence of any subject which a pupil or student is "very good at" or "very weak in" greatly affects him at elementary school or junior high school.

The students who are "very good at" Japanese language, English language and social studies tend to decide to select the non-NS&E course at early stages.

On the contrary, the students who are "very good at" physics, chemistry and mathematics tend to decide to select the NS&E course at early stages.

Furthermore, also the students who are "very weak in" mathematics, chemistry, physics and earth science tend to decide to select the non-NS&E course at early stages.

The students who are "very weak in" Japanese language and social studies also tend to decide to select the NS&E course at early stages. These tendencies coincide with the tendency that the students who "gave high priority to" their favorite subjects when deciding the departments to be selected decided the departments to be selected, earlier ("good at mathematics" and "good at science" - NS&E course, "good at Japanese language", "good at English language", "good at social studies" - non-NS&E course).

Therefore, preventing elementary school pupils and junior high school students from being conscious to be weak in mathematics, chemistry and physics or positively making them conscious to be good at these subjects is surmised to be effective for increasing the students wishing to select the NS&E course before their entrance to senior high schools.

(2) The existence of strong intellectual curiosity greatly affects the elementary school pupils' or junior high school students' decision of career selection.

The students who "gave high priority to" such a nature as "like to theoretically pursue the principles and mechanisms of things", "interested in natural phenomena and organisms", "like making things and elaborate and steady performance" or "wish to study leading matters of today" highly tend to decide to select the NS&E course at earlier stages.

On the contrary, the students who "gave high priority to"

such a nature as "very interested in the language and culture of any foreign country", "wish to think about human beings and life" or "interested in social mechanisms and movements" highly tend to select the non-NS&E course at earlier stages.

Furthermore, the students who "gave high priority to "can study what they like" or wish to lead university life with heavy emphasis placed on "study or research" tend to decide their courses at earlier stages irrespective of NS&E course or non-NS&E course.

(3) Whether students "wish to enjoy university life" greatly affects the decision to select the non-NS&E course at the 3rd year of senior high school.

The tendency to "give high priority" to such items as "wish to enjoy university life" and "the university wished to be entered is located in an urban area" is highly observed with those who decided to select the non-NS&E course at the 3rd year of senior high school.

The tendency of wishing to spare "much" energy on "circle or club activities", "relations with friends", "heterosexual communication" or "tours and leisure" in the university is highly observed with the students who decided to select their courses at the 3rd year of senior high school, irrespectively of NS&E course or non-NS&E course.

(4) There is certain correlation between the departments wished to be selected, and the timing of deciding the career selection.

The students wishing to select the law-, literature-, education- and science-related departments tend to decide their career selection earlier.

The students wishing to select the economics- and commercial science/business administration-related departments tend to decide their career selection later.

(5) There is certain correlation between the desired jobs and the timing of deciding the departments to be selected.

Among the students wishing to select the non-NS&E course, those who wish to select, as their jobs, "educational service", "public officer, public corporation employee, etc.", "judicial service" or "professional (novelist, interpreter, scenario writer or professor, etc.)" tend to decide their departments to be selected, earlier.

On the contrary, those wish to select, as their jobs, "financial or distribution service" or "company planning, sale, accounting or general affairs" tend to decide the departments to be selected, later.

Among the students wishing to select the NS&E course, those who wish to select, as their jobs, "scientific or technological researcher", "mechanical or electrical engineer" or "information processing service" tend to decide their departments to be selected, earlier.

(6) The students who decided their departments to be selected, at the 2nd to 3rd year of senior high school tend to give priority to "less overwork and more holidays", "good salary" and "high

possibility of success" in their future job selection.

(7) The students who decided their departments to be selected, at early stages tend to "give high priority" to "can use knowledge, etc.", "can be dedicated one speciality.", and "can do what I like" in their future job selection.

These tendencies coincide with the tendencies that those who "are interested in social events" or "like reading and writing sentences" tend to decide to select the non-NS&E course at early stages and that those who "know mechanisms", "like making plastic models and handicraft" and "like manipulating a personal computer, etc." and "like scientific experiments, etc." tend to decide to select the NS&E course. (Concerned with Q17)

(8) Those who are highly interested in science and technology or those who have positive comments on science and technology tend to decide to select the NS&E course at early stages.

(9) Conclusions

<1> The career selection by elementary school pupils and junior high school students between NS&E course and non-NS&E course seems to be greatly affected by the following factors:

(a) Existence of any subject a pupil or student is "very good at" or "very weak in", and the subject concerned

Factors to promote the selection of NS&E course:

"Very good at" physics, chemistry or mathematics.

"Very weak in" Japanese language or social studies.

Factors to promote the selection of non-NS&E course:

"Very good at" Japanese language, English language or social studies

"Very weak in" mathematics, chemistry, physics or earth science.

(b) Existence of strong intellectual curiosity, and its object

Factors to promote the selection of NS&E course:

Strong interest in principles and mechanisms of things, natural phenomena and making things.

Factors to promote the selection of non-NS&E course:

Strong interest in societies of foreign countries, life and social mechanism.

(c) Contents of desired job (whether knowledge can be used, whether speciality can be maintained, or whether what is liked can be done)

Those who especially give priority to the speciality of knowledge tend to wish to select the NS&E course.

<2> Those who decided to select the non-NS&E course at the 2nd to 3rd year of senior high school seem to be affected by their strong desire to enjoy university life.

Those wishing to select the economics- or commercial science/business administration-related department seem to be especially strong in this tendency (to decide their departments to be selected, at the 2nd to 3rd year of senior high school by giving priority to enjoying university life).

Table 1 Numbers of students wishing to select NS&E and non-NS&E course in respective school phases when the intended major has been decided

Time of decision	Students wishing to select non-natural-science course	Students wishing to select natural-science course	Total
Before about 5th - 6th year at elementary school	184 People (34.4%)	351 People (65.6%)	535 People (100%)
From about 5th - 6th year at elementary school to about 2nd year at junior high school <Course wished to be selected at about 5th - 6th year at elementary school>	416 People (47.3%) Not decided 95.9% Natural 4.0%	464 People (52.7%) Not decided 98.1% Non-Natural 1.9%	880 People (100%)
From about 2nd year at junior high school to 1st term of 2nd year at senior high school <Course wished to be selected at about 2nd year at junior high school>	1,088 People (60.8%) Not decided 82.3% Natural 17.8%	702 People (39.2%) Not decided 91.3% Non-Natural 8.7%	1,790 People (100%)
From 1st term of 2nd year at senior high school to 2nd term of 3rd year at senior high school <Course wished to be selected at about 1st term of 2nd year at senior high school>	370 People (70.3%) Not decided 45.9% Natural 54.0%	156 People (29.7%) Not decided 76.9% Non-Natural 23.1%	526 People (100%)
Total	2,058 People (55.2%)	1,673 People (44.8%)	3,731 People (100%)

Appendix 3

Senior high school students' consciousness of career selection in relation with whether or not they had wished to select the other course

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1. Outline of students who had once wished to select the other course

1.1 Frequency of changing the course to be selected

The students who had once wished to select the other course are found more in those wishing to select the non-NS&E course. This suggests that those wishing to select the NS&E course are more liable to change their course to be selected. (See Table 1)

[TABLE 1 ABOUT HERE]

As for the departments wished to be selected as the first candidates, those who had wished to select the non-NS&E course but changed their minds to select the NS&E course are characteristically relatively larger in the rate of selecting the medical/dental-related department and relatively smaller in the rate of selecting the engineering-related department than those who have consistently wished to select the NS&E course. On the other hand, those who had wished to select the NS&E course but changed their minds to select the non-NS&E course are larger in the rates of selecting the economics- and commercial science/business administration-related departments.

1.2 Timing for changing the course to be selected

As shown in Table 2, of those who had wished to select the NS&E course but changed their minds to select the non-NS&E course, about one half of them changed their course from the NS&E course to the non-NS&E course at the 2nd to 3rd year of senior high school. The change from the non-NS&E course to the NS&E course seems to occur at earlier stages.

[TABLE 2 ABOUT HERE]

2. Factors to promote and inhibit the change from NS&E course to non-NS&E course

Since the fluctuation in the number of those wishing to select the NS&E course is surmised to be considerably affected by the existence of those who had once wished to select the NS&E course but changed their minds to finally select the non-NS&E course. So, with attention paid to those who had wished to select the NS&E course but changed their minds to select the non-NS&E course, what outstanding features they have compared to

those who have consistently wished to select the NS&E course is attempted to be analyzed below.

2.1 Subjects which students are good at and weak in

For each subject, those who replied "very good at" or "very weak in" were identified respectively. Then, the percentages of those who replied so to all the students who had wished to select the NS&E course but changed their minds to select the non-NS&E course, and the percentages of those who replied so to all the students who have consistently wished to select the NS&E course were respectively calculated, and the ratios of the former to the latter were calculated respectively. Based on the ratios obtained like this, how far the subjects they were good at or weak in promoted or inhibited their selection of NS&E course was examined. (Table 3)

[TABLE 3 ABOUT HERE]

The A/B ratios of Table 3 are arranged in the order of values in Fig. 1.

As a result, the largest factor which promotes the change from the NS&E course to the non-NS&E course in relation with the subjects the students are good at or weak in seems to be the consciousness of being "very weak in mathematics".

The second largest factor is the consciousness of being "very good at Japanese language" which is followed by "very weak in chemistry" and "very weak in physics".

On the other hand, the largest factor to inhibit the change from the NS&E course to the non-NS&E course is the consciousness of being "very good at physics" which is followed by "very good at chemistry" and "very weak in Japanese language" in this order.

Judging from the above, to prevent the change from the NS&E course to the non-NS&E course in the final stage of deciding career selection, it must be most effective to let students be conscious that they are good at and not weak in "mathematics", "chemistry" and "physics".

[FIG. 1 ABOUT HERE]

The tendency that the students "very good at Japanese language" drift away from the NS&E course makes us feel that the books popularly read by the students good at Japanese language do not contain anything to arouse the interest in science or engineering. Supplying many high quality books describing the relation between science & technology and society, lives of scientists and engineers, etc. (of course, interesting enough also for senior high school students) is also surmised to be effective for preventing the change from the NS&E course to the non-NS&E course in the stage of senior high school.

2.2 Items given priority to in the decision of career selection

What consciousness plays a major role in the change from the NS&E course to the non-NS&E course? This question is pursued

below by analyzing the "item given high priority to" in deciding career selection. The rate of those who gave high priority to any specific item when they decided their career selection generally heavily depends on whether the group is students wishing to select the NS&E course or non-NS&E course. Furthermore, in the case of those wishing to select the non-NS&E course, the rate may also depend on whether they had once wished to select the NS&E course or they have consistently wished the non-NS&E course. In this case, if any item is given priority very differently between those who had wished to select the NS&E course but changed their minds to select the non-NS&E course and those who have consistently wished to select the non-NS&E course respectively, then the item can be considered, not as an attribute of those simply wishing to select the non-NS&E course, but to reflect a feature of the experience of those who had once considered to select the NS&E course but decided to select the non-NS&E course as a result of comparison between both the courses. Such items are shown in Table 4.

[TABLE 4 ABOUT HERE]

This table seems to suggest that those who changed their course from NS&E to non-NS&E are more conscious of
<1> Wishing to enjoy university life (if possible in urban area)
<2> Wishing to avoid disadvantage in future life
<3> Being interested in human beings and society
than those who have consistently wished to select the non-NS&E course, and that the NS&E course does not meet these requirements sufficiently.

The above conclusion can be endorsed by similar analysis of the question, "What do you want to spare your energy for in your university life ?". From the answers to this question, based on the same concept as above, the items are enumerated below, for which energy is wanted to be spared characteristically by those wishing to select the non-NS&E course after they had once wished to select the NS&E course.

Circle or club activities
Relations with friends
Heterosexual communication
My hobby
Acquisition of license
Employment
Part-time job
Tours and leisure

It can be seen that these students are commonly conscious of enjoying university life and being prepared for future employment.

Furthermore, the replies to a question on the items the students gave priority to for their job selection were similarly analyzed. The results suggest that the items the students characteristically gave priority to in their change of career selection from the NS&E course to the non-NS&E course are

Large company
High possibility of success
Advantage for marriage

These students are characteristically highly interested in the merits in social life received as a reward for working, rather than in what they do.

2.3 Information referred to in deciding career selection

What information was referred to for deciding career selection and how far was compared between those who have consistently wished to select the NS&E course and those who had wished to select the NS&E course but changed their minds to select the non-NS&E course. Table 5 shows respective information sources together with the percentages of the students consistently wishing to select the NS&E who referred to the respective sources (those who "very referred to" and "significantly referred to"), and also the percentages of the corresponding students wishing to select the non-NS&E course after having wished to select the NS&E course. Furthermore, the ratio of these two groups of students is shown for each information source.

[TABLE 5 ABOUT HERE]

Similar data for those consistently wishing to select the non-NS&E course and those wishing to select the NS&E course after having wished to select the non-NS&E course are shown in Table 6.

[TABLE 6 ABOUT HERE]

From B/A columns of Tables 5 and 6, it can be seen that those who changed their course from non-NS&E to NS&E is rather passive to outside information compared to those consistently wishing to select the non-NS&E course, while those who changed their course from NS&E to non-NS&E positively referred to outside information compared to those consistently wishing to select the NS&E course. This makes us presume that external information exerts certain influence on the change of career selection from NS&E to non-NS&E.

The respective information sources are arranged in the order of B/A values of Table 5 in Fig. 2. The contents of the question in the questionnairing do not clarify what ways the respective information sources were used in. However, the figure suggests the following:

<1> The information sources most senior high school students are exposed to, such as parents, class mates, senior high school teachers, career guidance materials prepared by senior high schools and sham examinations performed outside schools do not affect the change from NS&E course to non-NS&E course so significantly.

<2> The discussion with teachers of elementary and junior high school ages is effective in promoting the change of career selection from the NS&E course to the non-NS&E course, even though the percentage of the students who referred to it was small.

<3> The mass media information of TV or radio is also effective in promoting the change of career selection from the NS&E course to the non-NS&E course, even though the percentage of the students who referred to it was small.

<4> Materials of correspondence education are effective for promoting the change of career selection from the NS&E course to the non-NS&E course.
<5> The information obtained through pamphlets of universities, explanation meetings held by universities, etc. (the information prepared with an intention to describe each university in detail) is effective in promoting the change of career selection from the NS&E course to the non-NS&E course.
<6> The information provided by senior acquaintances, seniors of clubs, etc., relatives, etc. is effective in promoting the change of career selection from the NS&E course to the non-NS&E course. That is, the information given by the adults whom senior high school students would like to consult with for their career selection tends to promote the change of career selection from the NS&E course to the non-NS&E course.

[FIG. 2 ABOUT HERE]

Some of the above items are discussed below.

As for the possibility that the discussion with teachers of elementary and junior high school ages is effective in promoting the change of career selection from the NS&E course to the non-NS&E course, since the students wishing to select the education-related department in the non-NS&E course tend to refer to the discussion with teachers of elementary and junior schools ages, as shown in Appendix 1, it can be imagined that the discussion with teachers of elementary and junior high school ages affected, to some extent, the change of career selection from the NS&E course to the education-related department in the non-NS&E course.

The possibility that the information provided by TV & radio, pamphlets of universities, explanation meetings held by universities, etc. is effective in promoting the change of career selection from the NS&E course to the non-NS&E course makes us fear that the information given through these media emphasizes the brightness of non-NS&E departments as the image of universities, while depicting NS&E departments as places of severe learning with a plain image. Natural science departments are desired to work out a strategy to make themselves effectively appeal to senior high school students and to positively respond by changing their image according to the strategy.

Finally, we wish to discuss the possibility that the information given by senior acquaintances is effective in promoting the change of career selection from the NS&E course to the non-NS&E course. When a senior high school student who wishes to select the NS&E course but considers to change his mind to select the non-NS&E course is going to consult with any senior acquaintance, whom is he going to consult with ? Probably, the acquaintance he is going to consult with must be a person with an occupation in a position to know the job or life of a scientist or engineer.

Prime Minister's Office conducted a public opinion poll on how the people engaged in respective job categories evaluate the social position of scientists, and published the results. (Table 7)

[TABLE 7 ABOUT HERE]

This poll classifies occupations into 10 job categories. Among the job categories, the one most frequently in touch with scientists and engineers must be managers and engineers (employed). In the replies to another question (Are you interested to "listen to talks of scientists and engineers if you have such a chance" ?) in the same poll, managers and engineers (employed) are highest in the consciousness of being interested in listening to the talks of scientists and engineers. Therefore, it can be presumed that the adults who are liable to exert the largest influence on the senior high school students unable to decide their career selection between the NS&E course and the non-natural course must be the people engaged in this job category.

Table 7 shows that the managers and engineers (employed) evaluate the social position of scientists at the lowest level among the people of all the job categories. Therefore, the tendency that the high school students who referred to the discussion with senior acquaintances for the decision of career selection change their career selection from the NS&E course to the non-NS&E course may be a matter of course, considering such social background.

2.4 Image of "brightness" and "darkness"

The students who changed their career selection from the NS&E course to the non-NS&E course have a negative image about "brightness" in the university life of NS&E course and in the jobs of graduates from the NS&E course (design engineers, scientific and technological researchers) compared to those consistently wishing to select the NS&E course or non-NS&E course, and on the contrary have a positive image about the "brightness" in the university life of non-NS&E course and in the jobs of graduates from the non-NS&E course (bank clerks), as a large feature. (See Table 8, and Figs. 3 and 4.)

[TABLE 8 AND FIGS. 3 & 4]

From the above it can be presumed that the change of career selection from the NS&E course to the non-NS&E course is greatly affected by the image of sociability relating to jobs and the image of "brightness" and "darkness" about student lives and jobs.

Thus, if students cherish, by any cause, an image that the jobs of graduates from the NS&E course are less sociable or that the university life of NS&E course and the jobs taken by them after graduation are dark, it may cause them to drift away from the NS&E course. The image of the sociability of jobs and the image of the "brightness" of university life and jobs will have to be taken into consideration for tempting competent students toward the NS&E course.

2.5 Attitudes toward science and technology

How the attitudes toward science and technology affected the career selection by senior high school students was analyzed by examining the factors to promote or inhibit the change of career selection from the NS&E course to the non-NS&E course (comparison between those wishing to select the non-NS&E course after having wished to select the NS&E course and those consistently wishing to select the NS&E course) and factors to promote or inhibit the consistent selection of non-NS&E course (comparison between those consistently wishing to select the non-NS&E course and those consistently wishing to select the NS&E course). Results are shown in Table 9 and Fig. 5.

[TABLE 9 AND FIG. 5 ABOUT HERE]

From Fig. 5, the following can be compiled.

<1> Factors relating to the consistent selection of non-natural-science course

Large promotion factors include low interest in the process of science and technology, passiveness in enjoying the benefit of leading science and technology such as personal computers, and low evaluation on the importance of science and technology in the society. The passive evaluation on the fruits of science and technology is also effective in promoting the career selection of non-NS&E course, but is not so very effective.

Large inhibition factors are high interest in the process of science and technology, understanding on the necessity of science and technology in the society, and positiveness in enjoying the benefit of leading science and technology. The positive evaluation on the fruits of science and technology is also effective in inhibiting the career selection of non-NS&E course, but is not so very effective.

<2> Factors relating to the change of career selection from NS&E course to non-NS&E course

Promotion factors are the same as the factors promoting the consistent career selection of non-NS&E course, but generally they are lower in effect. However, the low evaluation on the importance of science and technology in the society seems to be a factor as effective as for promoting the consistent career selection of non-NS&E course.

Inhibition factors are also the same as the factors for inhibiting the consistent career selection of non-NS&E course, but they are generally very lower in effect. Especially the positiveness in enjoying the benefit of leading science and technology is very less effective, and can be said to be almost effectless.

Therefore, to prevent the change of career selection from the NS&E course to the non-NS&E course, it is most effective to enhance the interest in the process of science and technology, and the second most effective means is surmised to be to intensity the recognition on the importance of science and technology in

the society. On the other hand, an action to simply intensify the positiveness of utilizing the latest fruits of science and technology cannot be considered so effective in view of preventing the senior high school students' change of career selection from the NS&E course to the non-NS&E course.

Table 1 Numbers of the students who had once wished to select the other course, and the top three departments wished to be selected as the first candidates

	Number of students	Department wished to be selected
Those who have consistently wished to select natural science course	1,553	① Engineering (46.7%) ② Science (15.8%) ③ Medical/dental (13.3%)
Those who had wished to select non-natural-science course but changed their minds to select natural science course	120	① Engineering (27.5%) ② Medical/dental (22.5%) ③ Science (18.3%)
Those who have consistently wished to select non-natural-science course	1,606	① Law (20.3%) ② Economics (16.8%) ③ Literature (14.3%)
Those who had wished to select natural science course but changed their minds to select non-natural-science course	452	① Economics (22.6%) ② Law (16.8%) ③ Comm/admin. (12.2%)

Table 2 Courses wished to be selected at about the 1st term of 2nd year at senior high school

Course wished to be selected about 1st term of 2nd year at senior high school	A	B
Same as the course finally decided to be selected	62.5%	49.1%
Not decided	7.5%	6.6%
The other course	30.0%	44.2%
Total	100.0%	100.0%

A : Those who had wished to select non-natural-science course but changed their minds to select natural science course

B : Those who had wished to select natural science course but changed their minds to select non-natural-science course

Table 3 Subjects they are good at or weak in, in relation with their change from natural science course to non-natural-science course

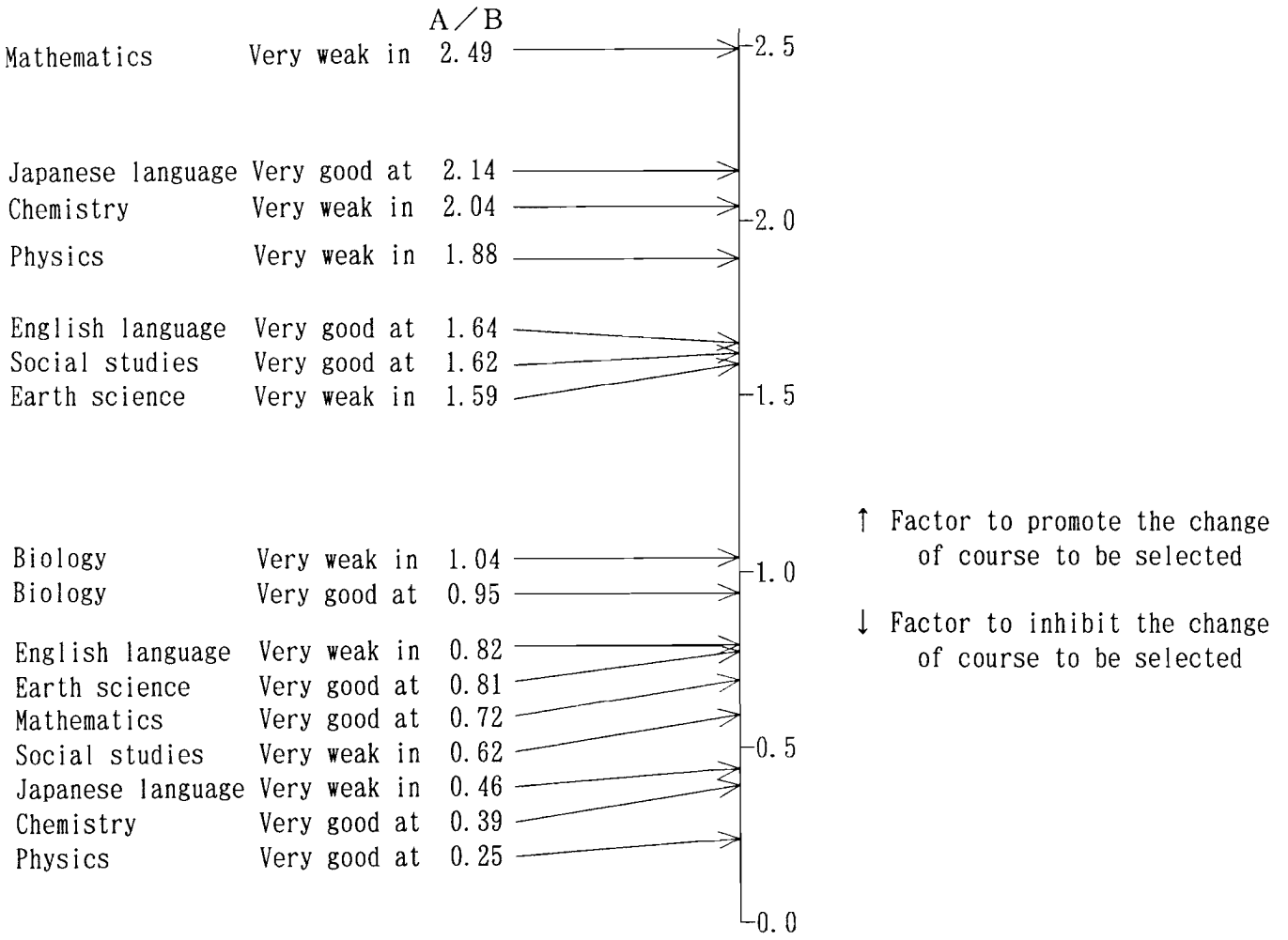
Subject		A (%)	B (%)	A／B
Japanese language	Very good at	6.2	2.9	2.14 ②
	Very weak in	15.5	33.4	0.46 ⑭
Mathematics	Very good at	6.4	8.9	0.72 ⑫
	Very weak in	25.4	10.2	2.49 ①
English language	Very good at	6.9	4.2	1.64 ⑤
	Very weak in	22.8	27.9	0.82 ⑩
Social studies	Very good at	10.2	6.3	1.62 ⑥
	Very weak in	14.6	23.4	0.62 ⑬
Physics	Very good at	1.5	6.1	0.25 ⑯
	Very weak in	40.9	21.7	1.88 ④
Chemistry	Very good at	3.3	8.4	0.39 ⑮
	Very weak in	28.3	13.9	2.04 ③
Biology	Very good at	3.8	4.0	0.95 ⑨
	Very weak in	16.8	16.1	1.04 ⑧
Earth science	Very good at	1.7	2.1	0.81 ⑪
	Very weak in	28.3	17.8	1.59 ⑦

A : Rate in those who had wished to select natural science course but changed their minds to select non-natural-science course (%)

B : Rate in those who have consistently wished to select natural science course (%)

Note: Circled numerals show ranking of A/B.

Fig. 1 Influence of subjects which students are good at or weak in, on the change from natural science course to non-natural-science course



Note: The numerals are A/B ratios of Table 3.

Table 4 Items featuring those who had wished to select natural science course but changed their minds to select non-natural-science course, selected out of the items given priority to in the decision of career selection

Item	Rate of those who gave priority to (%)			
	A	B	C	A／B
Think about human beings and life	23.2	20.0	8.0	1.16
Interested in social mechanisms and movements	33.0	28.7	6.0	1.15
Number of entrance examination subjects	27.7	25.0	16.7	1.11
Advantageous for employment and promotion	26.3	22.3	22.0	1.18
University wished to be entered is located in urban area	15.5	13.2	7.3	1.17
Wish to enjoy student life	47.6	43.0	32.2	1.11
University wished to be entered is famous	20.1	16.7	12.0	1.20
Affluent future life is assured	20.1	14.8	15.1	1.36

A : Those who had wished to select natural science course but changed their minds to select non-natural-science course (A)
B : Those who have consistently wished to select non-natural-science course
C : Those who have consistently wished to select natural science course

Table 5 Percentages of students who referred ("very" and "significantly") to respective information sources (those consistently wishing to select natural science course and those wishing to select non-natural-science course after having wished to select the natural science course in comparison)

Information source	A(%)	B(%)	B／A (%)
Magazine for university entrance examinees	73.1	81.9	1.12
TV or radio	8.2	11.1	1.35
Parent	47.6	51.1	1.07
Relative	32.2	37.0	1.15
Class mate	58.8	63.1	1.07
Friend outside school	18.2	21.0	1.15
Senior of club, etc.	28.7	33.5	1.17
Senior acquaintance	33.6	41.6	1.24
Teacher of elementary or junior high school age	5.9	9.5	1.61
Teacher of senior high school	52.9	56.0	1.06
Teacher of cram school, etc.	15.2	15.5	1.02
University pamphlet	46.4	58.0	1.25
Career guidance material of senior high school	59.5	59.8	1.01
Explanation meeting held by university	16.7	19.9	1.19
Sham examination outside school	57.9	57.1	0.99
Material of correspondence education, etc.	20.4	27.2	1.33

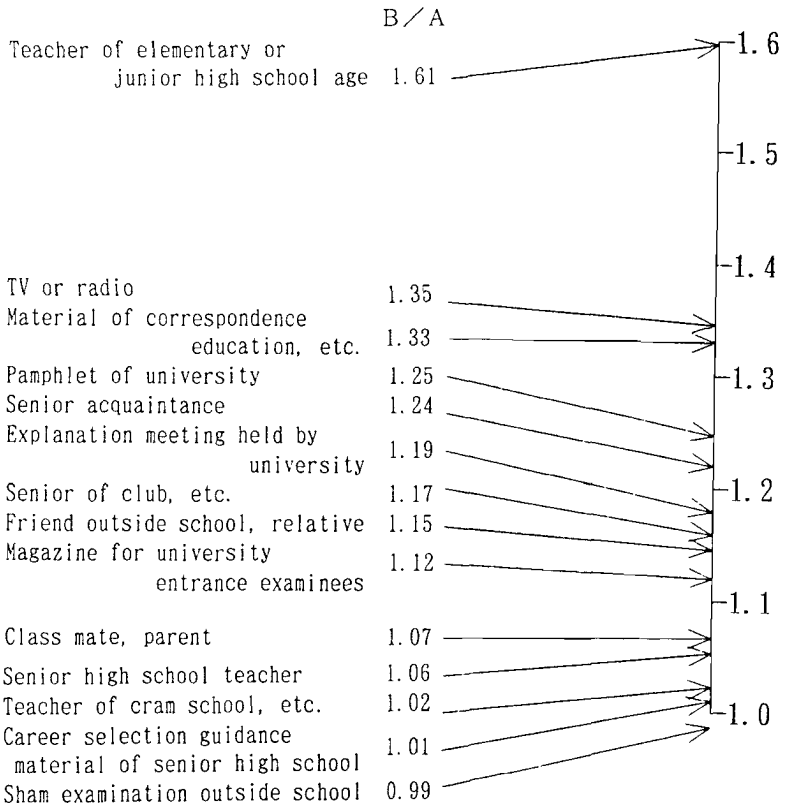
A : Percentage of those consistently wishing to select natural science course
B : Percentage of those wishing to select non-natural-science course after having wished to select natural science course

Table 6 Percentages of students who referred ("very" and "significantly") to respective information sources (those consistently wishing to select non-natural-science course and those wishing to select the natural science course after having wished to select non-natural-science course in comparison)

Information source	A(%)	B(%)	B／A (%)
Magazine for university entrance examinees	78.5	75.9	0.97
TV or radio	9.1	9.1	1.00
Parent	49.9	49.2	0.99
Relative	35.4	35.9	1.01
Class mate	66.8	56.7	0.85
Friend outside school	23.0	19.2	0.83
Senior of club, etc.	34.4	25.9	0.75
Senior acquaintance	38.0	38.3	1.01
Teacher of elementary or junior high school age	8.0	4.2	0.53
Teacher of senior high school	59.6	49.2	0.83
Teacher of cram school, etc.	16.6	17.5	1.05
University pamphlet	55.8	48.4	0.87
Career guidance material of senior high school	65.2	51.7	0.79
Explanation meeting held by university	20.3	12.5	0.62
Sham examination outside school	60.5	49.2	0.81
Material of correspondence education, etc.	29.3	31.6	1.08

A : Percentage of those consistently wishing to select non-natural-science course
B : Percentage of those wishing to select natural science course after having wished to select non-natural-science course

Fig. 2 Relation between the change of the course wished to be selected from natural science to non-natural-science and outside information sources



Note: Numerals are B/A values of Table 5.

Table 7 Evaluation on the social position of scientists by people engaged in respective job categories (Replies to a question, "Do you think the social position of scientists is generally high ?")

Occupational category	Marks
1. Agriculture, forestry and fishery (proprietor)	71.2
2. The jobless other than housewives and students	65.6
3. Agriculture, forestry and fishery (employed family members)	57.1
4. Physical workers (employed)	48.1
5. Commercial and industrial services and free lancers (proprietors)	42.5
6. Commercial and industrial services and free lancers (employed family members)	40.9
7. Students (jobless)	39.0
8. Housewives (jobless)	38.9
9. Office workers (employed)	26.3
10. Managers and engineers (employed)	2.4

Note 1: Scores given to each answer, 300 to "Yes, indeed.", 100 to "Yes.", 0 to "I don't know.", -100 to "No.", and -300 to "Never." were averaged.
Note 2: Prepared based on the data stated in "Public Opinion Census of Science & Technology and Society" (surveyed in January, 1990, by Public Relations Division, Prime Minister's Office).

Table 8 Image about "brightness" cherished for the student life of natural science and non-natural-science courses and for he jobs of graduates from the respective courses

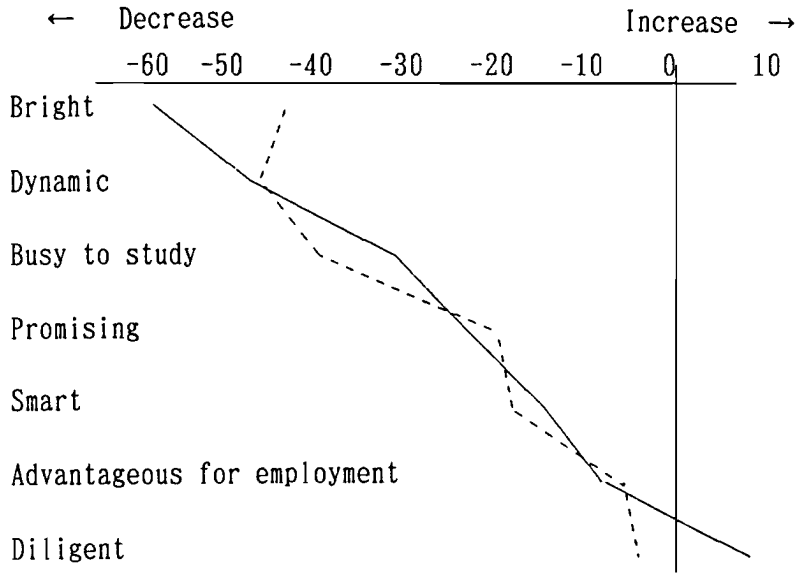
	A	B	C
student life of natural science course	-4.6	-48.2	-63.8
Job of graduates from natural science course			
Design engineer	17.0	2.1	-6.2
Scientific and technological researcher	-73.0	-93.9	-108.9
Student life of non-natural-science course	104.8	135.3	153.7
Job of graduates from non-natural-science course			
Bank clerk	18.7	-3.0	21.9

A : Students consistently wishing to select natural science course
B : Students consistently wishing to select non-natural-science course
C : Students wishing to select non-natural-science course after having wished to select natural science course

Note: Scores given to image about "brightness", 300 to "very bright", 100 to "rather bright", 0 to "neither", -100 to "rather dark" and -300 to "very dark" were averaged.

Fig. 3 Various images cherished for the student life of natural science course by university entrance examinees

A : Degree of image cherished by those consistently wishing to select natural science course
B : Degree of image cherished by those wishing to select non-natural-science course after having wished to select natural science course
C : Degree of image cherished by those consistently wishing to select non-natural-science course

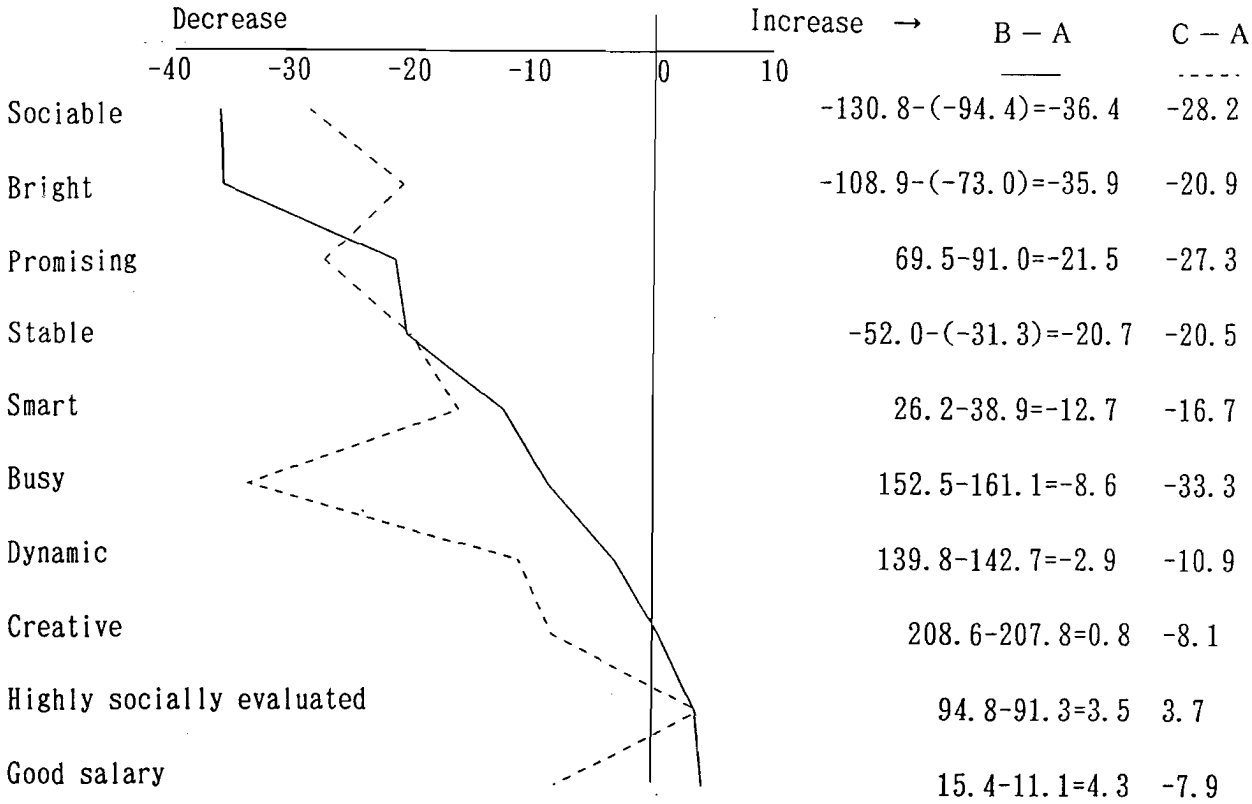


	B − A	C − A
	——	-----
Bright	-63.8-(-4.6)=-59.2	-43.6
Dynamic	48.0-95.0=-47.0	-46.4
Busy to study	185.5-217.1=-31.6	-39.0
Promising	122.0-145.3=-23.3	-20.1
Smart	28.1-43.5=-15.4	-18.5
Advantageous for employment	132.8-140.1=-7.3	-5.9
Diligent	119.7-111.5=8.2	-3.0

Note: Marks given to each degree of image, ±300 to "very" and ±100 to "rather" were averaged.

Fig. 4 Various images cherished about scientific and technological researchers by university entrance examinees

A : Degree of image cherished by those consistently wishing to select natural science course
B : Degree of image cherished by those wishing to select non-natural-science course after having wished to select natural science course
C : Degree of image cherished by those consistently wishing to select non-natural-science course



	B − A	C − A
Sociable	-130.8-(-94.4)=-36.4	-28.2
Bright	-108.9-(-73.0)=-35.9	-20.9
Promising	69.5-91.0=-21.5	-27.3
Stable	-52.0-(-31.3)=-20.7	-20.5
Smart	26.2-38.9=-12.7	-16.7
Busy	152.5-161.1=-8.6	-33.3
Dynamic	139.8-142.7=-2.9	-10.9
Creative	208.6-207.8=0.8	-8.1
Highly socially evaluated	94.8-91.3=3.5	3.7
Good salary	15.4-11.1=4.3	-7.9

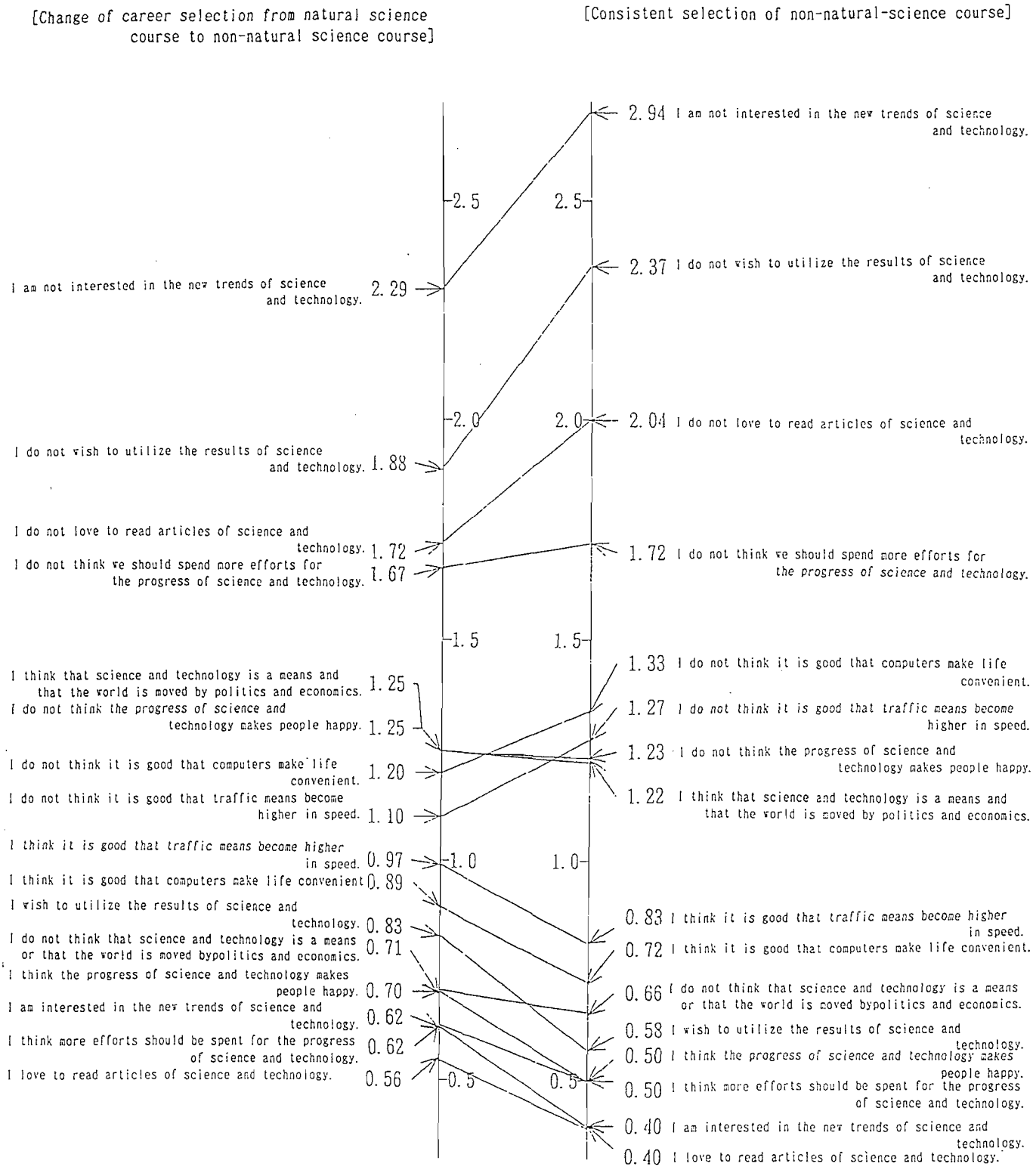
Note: Marks given to each degree of image, ±300 to "very" and ±100 to "rather" were averaged.

Table 9 Experience of having wished to select the other course and attitudes toward science and technology

A : Students wishing to select non-natural-science course after having wished to select natural science course
B : Students consistently wishing to select non-natural-science course
C : Students consistently wishing to select natural science course

		A	B	C	(A／C) $\frac{452}{1,553}$	(B／C) $\frac{1,606}{1,553}$
Whole		452	1,606	1,553		
I love to read newspaper articles of science and technology.	Yes	127	321	783	0.56	0.40
	No.	167	703	334	1.72	2.04
I am interested in scientific and technological trends such as super-conductivity.	Yes	177	405	989	0.62	0.40
	No.	148	675	222	2.29	2.94
I wish to positively utilize the latest results of science and tech-nology.	Yes	225	559	933	0.83	0.58
	No.	95	426	174	1.88	2.37
It is good that traffic means become higher in speed.	Yes	233	700	822	0.97	0.83
	No.	90	369	281	1.10	1.27
It is good that computers are developed to make life convenient.	Yes	201	580	780	0.89	0.72
	No.	97	382	278	1.20	1.33
The progress of science and technology makes people happy.	Yes	68	172	334	0.70	0.50
	No.	159	556	438	1.25	1.23
Science is a means, and the world is moved by politics and economics.	Yes	158	549	435	1.25	1.22
	No.	118	389	568	0.71	0.66
More efforts should be spent for science and technology.	Yes	120	340	633	0.62	0.50
	No.	101	369	208	1.67	1.72

Fig. 5 Career selection between natural science course and non-natural-science course, and attitudes toward science and technology



Appendix 4

Multivariate analysis of senior high school students' consciousness structure

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1. Purpose of multivariate analysis

This survey asked senior high school students questions, to identify their consciousness of their career selection, their images on jobs, attitudes toward science and technology, etc. However, the items regarding consciousness used in the questionnaire do not cover properly all the consciousness desired to be identified. For example, Question 9 enumerates 21 items as possible factors for deciding their courses in universities, asking which of them affected them in their decision. However, there may have been other factors which were not included in the enumerated factors and on the contrary, the enumerated items may have included which had nothing to do with their decision. This can inevitably happen with surveys of consciousness due to technical restrictions.

So, it is required to extract essential factors not affected by individual items enumerated. Since the enumerated items can be considered to reflect essential factors more or less, if there is any method for extracting essential factors from the results of the survey, the purpose can be achieved. A technique used in such a case is multivariate analysis, above all, factor analysis.

Furthermore, Question 12 asked the image of university life. Also to analyze a problem as to what is the essential difference between the image of university life in the non-NS&E course and that in the NS&E course, multivariate analysis can be applied. For a problem as to what image item is outstanding, analysis such as Hayashi's Quantification theory II can be applied.

Thus, multivariate analysis clarifies the relative relations among plural items and allows the structural identification of problems even though these cannot be found by analysis of individual question items. The following describes the multivariate analysis performed to identify structures relating to several questions.

2. Analysis of consciousness structure in career selection

2.1 Method

Factors for deciding the university course were extracted by factor analysis. In reference to Question 9, "To what degree did you give priority to the following items when you decided the department or speciality in the university?",analysis was effected according to the principal factor method based on the iterative estimation of communality. Furthermore, for better under-

standing of structure, the structure was simplified by Varimax rotation (this operation does not change the relative structure). The factor scores were estimated by regression method.

Five items low in communality, L (number of examination subjects of the university wished to be entered), M (can study what I like), O (like reading books or making experiments alone, rather than keeping troublesome relations with people), Q (wish to acquire a license) and S (wish to enjoy university life) were eliminated (communality is a term in factor analysis; an item low in communality is not a real factor for course decision or a highly peculiar factor, and is generally eliminated from the essential structure). Calculation was made using 3718 samples which replied to all items.

2.2 Consciousness structure in course decision

The factor structure obtained as a result of the analysis is as shown in Table 1. Three essential factors were obtained. (Table 1 shows them as F1, F2 and F3 in the order of variance. A variance is an indicator to show the magnitude of influence of each factor on the course selection.) Each numeral in the table shows the correlation degree between the corresponding item and the corresponding factor obtained. From the correlation degrees with the respective items, the nature of each factor can be estimated.

[TABLE 1 ABOUT HERE]

For example, the first factor (F1) is large in correlation with D (interested in various natural phenomena and organisms), E (like to theoretically pursue the principles and mechanisms of things, etc.), G (good at mathematics), J (good at subjects concerned with natural science (physics, chemistry, biology, etc.) and P (wish to study leading matters of today). These items show an inclination toward NS&E course. The second factor (F2) is large in correlation with A (very interested in the language and culture of any foreign country), B (wish to think about human beings and life), C (interested in social mechanisms and movements), H (good at Japanese language), I (good at English language) and K (good at subjects concerned with social studies (Japanese history, world history, etc.). These items show an inclination toward non-NS&E course. The third factor (F3) is large in correlation with N (advantageous for employment and promotion after employment), R (the university with the department wished to be selected is located in an urban area), T (the university wished to be entered is famous) and U (affluent life in future is assured). These items include the items concerned with future life and the items concerned with the value of the university for the individual. These two categories look different, but are common in the consciousness that the university or department is considered as a tool or means.

It can also be considered that the first and second factors are subjective factors of examinees, while the third factor is a factor of university side. So, the first factor can be called "self-consciousness of NS&E grounding"; the second factor, "self-

consciousness of non-NS&E grounding"; and the third factor, "consciousness to consider the university as a tool".

It can be said that the course decision for the university is based on three major factors of "self-consciousness of NS&E grounding", "self-consciousness of non-NS&E grounding" and "consciousness to consider the university as a tool".

2.3 Tendencies by attributes

Table 2 shows the means and standard deviations of factor scores for the respective attributes. The smaller the value for each question item, the more positive. So, the larger the value of each score in minus direction, the more strongly effective the factor.

How to read this table is described in reference to the factor scores by sex. The first factor scores are -0.135 for males and 0.259 for females. This shows that males are higher in the self-consciousness of NS&E grounding. Similarly, the second factor scores show that females are higher in the self-consciousness of non-NS&E grounding. For the third factor, there is little difference between males and females.

Similarly, by course wished to be selected, those wishing to select the NS&E course is higher in the self-consciousness of NS&E grounding, and those wishing to select the non-NS&E course is higher in the self-consciousness of non-NS&E grounding. If the courses wished to be selected are roughly classified into the NS&E course and the non-NS&E course, the "self-consciousness of NS&E grounding" and the "self-consciousness of non-NS&E grounding" directly affect the career selection.

However, if the courses wished to be selected are observed in more detail, there are also some different tendencies. Those wishing to select the science-related department are high in the "self-consciousness of NS&E grounding" and low in the "self consciousness of non-NS&E grounding", and in addition, low in the "consciousness to consider the university as a tool". Those wishing to select the engineering-related department within the same NS&E course is also high in the "self-consciousness of NS&E grounding", but not so high as those wishing to select the science-related department, and lower in the "self-consciousness of non-NS&E grounding" than those wishing to select the science-related department. The former is very different from the latter in that the former is rather high in the "consciousness to consider the university as a tool". Those wishing to select the medical/dental-related department are rather lower in the "self-consciousness of NS&E grounding" than those wishing to select the science- and engineering-related departments, and not so low in the "self-consciousness of non-NS&E grounding".

Those wishing to select the non-NS&E course are generally low in the "self-consciousness of NS&E grounding" and high in the "self consciousness of non-NS&E grounding". This typical tendency is shown by those wishing to select the literature-related department. However, the third factor, "consciousness to consider the university as a tool" is different from department to department. Those wishing to select the law-, economics- and commercial science/business administration-related departments

are high in the "consciousness to consider the university as a tool", while those wishing to select the other departments are low in the "consciousness to consider the university as a tool".

[TABLE 2 ABOUT HERE]

Therefore, at first, "self-consciousness of NS&E grounding" and "self-consciousness of non-NS&E grounding" lead to the NS&E course and the non-NS&E course respectively. Then, those wishing to select the NS&E course and with "consciousness to consider the university as a tool" wish to select the engineering-related department, and those wishing to select the non-NS&E course and with "consciousness to consider the university as a tool" wish to select the law-, economics- or commercial science/business administration-related department.

In relation with the school phase when the career to be selected was decided, those who decided earlier the career to be selected, irrespective of NS&E course or non-NS&E course, are stronger in the self-consciousness of their own grounding. The "consciousness to consider the university as a tool" shows no clear relation with any school phases.

Among those wishing to select the non-NS&E course, those who had once wished to select the NS&E course is strong in the "self-consciousness of non-NS&E grounding", but weaker than those who consistently wished. On the contrary, those who had once wished to select the non-NS&E course but changed their minds to select the NS&E course are stronger in the "self-consciousness of NS&E grounding" than those consistently wishing to select the NS&E course. This allows the interpretation that "even those with very high NS&E grounding may drift away from the NS&E course even temporarily" or that "high NS&E grounding is a decisive factor for wishing the NS&E course (those with high NS&E grounding swing from the non-NS&E course to the NS&E course)".

2.4 Conclusions

The decision of the career to be selected is affected by three major factors of "self-consciousness of NS&E grounding", "self-consciousness of non-NS&E grounding" and "consciousness to consider the university as a tool". Among them, the "self-consciousness of natural science grounding" is the largest in variance, to show that it is the strongest factor. The "self-consciousness of NS&E grounding" and the "self-consciousness of non-NS&E grounding" lead to the NS&E course and the non-NS&E course respectively. The "consciousness to consider the university as a tool" is a factor for deciding the department in the non-NS&E or NS&E course, and those wishing to select the NS&E course wish to select the engineering-related department, while those wishing to select the non-NS&E course wish to select the law-, economics- or commercial science/business administration-related department. Furthermore, those who decided earlier the career to be selected are stronger in the self-consciousness of corresponding NS&E grounding or non-NS&E grounding.

3. What is wished to be done in university life

3.1 Method

There must be various things which are wished to be done by senior high school students after their entrance into universities. To structurally itemize them, factor analysis was performed on the replies to Question 11 (What do you intend to spend your energy to in your university life after your entrance into your university?).

The analysis used 3824 samples which replied to all the items.

3.2 What is wished to be done in university life

The factor structure obtained as a result of analysis is as shown in Table 3.

As a result of factor analysis, three factors were extracted. The first factor (F1) is concerned with consumption items to enjoy university life such as B (circle or club activities), C (relations with friends), D (heterosexual communication), E (my hobby) and I (tours and leisure). The second factor (F2) is concerned with the items for using the university as a means for future employment such as F (acquisition of license), G (employment activities) and H (part-time job). The third factor (F3) is the only one factor concerned with the wish to pursue learning and knowledge as indicated by item A (study and research). However, the variance of the third factor is very small. Considering the structure, let's call the first factor "consumption-oriented university life", the second factor "tool-oriented university life" and the third factor "study-oriented university life".

[TABLE 3 ABOUT HERE]

3.3 Tendencies of respective attributes

Table 4 shows the means and standard deviations of factor scores for the respective attributes. The smaller the value for each question item, the more positive. So, the larger the value of each score in minus direction, the more strongly effective the factor.

By sex, females show minus values for all the factors. This means that in every aspect, females are clearer in the wish to do what they like. By course wished to be selected, those wishing to select the non-NS&E course give higher priority to "consumption-oriented university life". The females wishing to select the non-NS&E course tend to give priority to "tool-oriented university life", and the females wishing to select the NS&E course, to "study-oriented university life".

By department wished to be selected, the inclination for "consumption-oriented university life" is not so different among the respective departments, except that those wishing to select the science-related department are low in the inclination. This

suggests that the consumption aspect of university life is growing as a common tendency among all departments. Those wishing to select the science- and medical/dental-related departments are inclined for "study-oriented university life". Those wishing to select the economics-related department tend to be strongly inclined for "consumption-oriented university life" and "tool-oriented university life". Those wishing to select the commercial science/business administration-related department shows a similar tendency, but not so clearly as those wishing to select the economics-related department. Those wishing to select the education-related students are most clearly inclined for "tool-oriented university life".

[TABLE 4 ABOUT HERE]

In relation with school phases when the career to be selected was decided, those who decided earlier the career to be selected, irrespective of NS&E course or non-NS&E course, are more strongly inclined for "study-oriented university life" as a remarkable tendency.

As for those with experience of having wished to select the other course, those wishing to select the non-NS&E course after having wished to select the NS&E course are highly inclined for "consumption-oriented university life" and those wishing to select the NS&E course after having wished to select the non-NS&E course are highly inclined for "study-oriented university life". Furthermore, those wishing to select the NS&E course after having wished to select the non-NS&E course are lowly inclined for "tool-oriented university life". This suggests tendencies that some of those wishing to select the NS&E course who wish to enjoy university life swing to the non-NS&E course, and that those who swing from the non-NS&E course to the NS&E course give up "tool-oriented university life" and are inclined for "study-oriented university life".

3.4 Conclusions

The university life imagined by senior high school students includes three aspects; "consumption-oriented university life" to enjoy the university life, "tool-oriented university life" to consider the university as a means for future employment, and "study-oriented university life" to pursue learning and knowledge. In general, the inclination for "consumption-oriented university life" is not so different from department to department wished to be selected, except that those wishing to select the science-related department are low in the inclination, and the aspect of consumption in university life is going to be a common inclination among all the departments. For today's young people, the university is, first of all, a place to enjoy university life.

4. University life of non-NS&E course and university life of NS&E course - University life images -

4.1 Method

As described in the previous section of this report, for senior high school students who find consumption valuable in the university life, it is not preferable that university life is occupied by studying. So, if they think the university life of NS&E course is occupied by experiments, etc., they will drift away from the NS&E course. Therefore, after clarification on their expectation on university life, it is necessary to clarify what images they have on the university life of non-NS&E course and NS&E course.

This section analyzes the university life images of non-NS&E course and NS&E course in reference to replies to Question 12 "What image do you have on the university life of present university students ?". At first, the image of university life in non-NS&E course and that in NS&E course were examined by factor analysis, to compare what structures both the images have. Then, the data of non-NS&E and NS&E courses were put together, and analysis by Hayashi's quantification II was performed to clarify what is the difference between the university life images of non-NS&E and NS&E courses.

The factor analysis used 3821 samples for the university life image of non-NS&E course, and 3795 samples for the university life image of NS&E course. The analysis by Hayashi's quantification II used the samples of both the courses, i.e., 7616 samples.

4.2 Structures of images on the university life of non-NS&E course and NS&E course

The university life image of non-NS&E course can be summarized by two factors. (Table 5-1)

[TABLE 5-1 ABOUT HERE]

The image items corresponding to first factor (F1) such as "bright/dark", "dynamic/monotonous" and "smart/awkward" are concerned with the sense. The image items corresponding to second factor (F2) such as "busy/not busy to study" and "diligent/idle" are concerned with diligence. Tool-conscious image items such as "advantageous/disadvantageous for employment" and "promising/unpromising" have correlation with the two factors.

The university life image of NS&E course can be summarized by two factors. (Table 5-2)

[TABLE 5-2 ABOUT HERE]

Compared to the university life image of non-NS&E course, the first factor (F1) and the second factor (F2) are reversed. That is, the first factor has high correlation with the tool-conscious image items and the image items concerned with diligence, and the second factor has high correlation with the image items concerned with the sense. For the university life of non-NS&E course, the

tool-conscious image items are not clear in the correlation with the two factors, but in the results of factor analysis on the university life image of NS&E course, the tool-conscious image items have clearly correlation with the first factor.

In the comparison between non-NS&E and NS&E courses, the image of non-NS&E course is predominantly concerned with the sense, and that of NS&E course is predominantly concerned with diligence and tool consciousness. Both the images are in clear contrast.

4.3 Tendencies of respective attributes

With regard to the university life image of non-NS&E course (Table 6-1), those wishing to select the non-NS&E course, especially those wishing to select the law-, economics- and commercial science/business administration-related departments, and also those wishing to select the non-NS&E course after having wished to select the NS&E course tend to have a better impression on the university life of non-NS&E course (bright, dynamic and smart). The image that the university life of non-NS&E course is busy with studying and diligent is also cherished by those wishing to select the non-NS&E course, especially by those who decided to select the non-NS&E course already in the 5th to 6th year of elementary school.

For the university life image of NS&E course (Table 6-2), those wishing to select the engineering-related department and those wishing to select the NS&E course after having wished to select the non-NS&E course tend to think the university life is busy with studying and advantageous in view of tool. For the image items concerned with the sense relating to the second factor, those wishing to select the NS&E course, especially those wishing to select the engineering-related and medical/dental-related departments, and also those who decided to select the NS&E course at early stages tend to think the university life is positive in those image items. On the other hand, those wishing to select the law- and commercial science/business administration-related departments think the university life is relatively negative in those image items.

Therefore, the university life of non-NS&E course is considered to be relatively positive in image by those wishing to select the non-NS&E, and the university life of NS&E course is considered to be positive in image by those wishing to select the NS&E course. Irrespective of the course, senior high school students tend to have a university life image to warrant their career selection.

[TABLE 6-1 AND 6-2 ABOUT HERE]

4.4 Difference of images on non-NS&E and NS&E courses

What factors constitute the difference between the non-NS&E course and the NS&E course in university life image was examined by Hayashi's quantification II. The analysis clarified the image items which clearly separate both the images. (Table 7)

In Hayashi's quantification II, an item with a larger range

shows a factor for clearly separating both the images. In Table 7, two image items of "bright/dark" and "busy/not busy to study" clearly separate both the images. There clearly exist the images of bright non-NS&E university life and busily studying NS&E university life.

[TABLE 7 ABOUT HERE]

4.5 University life of non-NS&E course and that of NS&E course - Images of university life -

The university life image of non-NS&E course and that of NS&E course can be classified into two image aspects; one concerned with the sense as can be referred to as "bright", "dark", "smart", "awkward", etc. and the other concerned with diligence as can be referred to as "busy with studying", "not busy with studying", "diligent", "idle", etc. It was found that there are typical images of bright non-NS&E university life and busily studying NS&E university life as is often referred to. Thus, the university life images of non-NS&E and NS&E courses cherished by senior high school students are almost stereotypical. Even in these tendencies, those wishing to select the non-NS&E course tend to think the university life of non-NS&E course is more diligent and busier with studying, than those wishing to select the NS&E course do, and those wishing to select the NS&E course tend to think the university life of NS&E course is brighter, than those wishing to select the non-NS&E course do. Furthermore, relatively, those wishing to select the law-, and commercial science/business administration-related departments have a negative image on the university life of NS&E course.

5. Structure of factors for job selection

5.1 Method

If what viewpoints are taken by senior high school students when they are going to select their jobs can be known, we may be able to obtain a clue for tempting young people to the world of science and technology. So, what viewpoints are taken by senior high school students when they are going to select their jobs was examined based on the replies to Question 15 "How much priority do you give to the following items when you are going to select your jobs in future?". The number of samples analyzed was 3848.

5.2 Structure of job selection factors

As a result of factor analysis, three job selection factors were extracted (Table 8).

[TABLE 8 ABOUT HERE]

The first factor (F1) has high correlation with such items as large company, good salary, known company name, possibility of success, company stability, more holidays and advantage for marriage. The second factor (F2) has high correlation with such

items as contribution to the world, use of knowledge and techniques, speciality, and being able to do what one likes. The third factor (F3) has high correlation with being able to work in an urban area, being able to communicate with people and internationality.

The first factor is concerned with items relating to the natures of the organization they wish to work for, such as status value and advantage as living means, and so, we call the factor "affiliation merit". The second factor strongly reflects the aspect of the occupation to let workers feel the worth of living there, and so, we call the factor "sense of fulfillment through job". The third factor is concerned with items not directly relating to the organization or job category, and so, we call the factor "social aspect of job" (or smartness).

It is said that Japanese workers are employed to belong to companies rather than to do jobs. The first factor corresponding to the consciousness of affiliation is remarkably large, to express this tradition.

5.3 Tendencies of respective attributes

Table 9 shows the means and standard deviations of factor scores for respective attributes. The tendency to consider job selection based on the "affiliation merit" is remarkably observed among those wishing to select the engineering-, law- and commercial science/business administration-related departments. The "sense of fulfillment through job" tends to be given higher priority by females than males, and by those wishing to select the NS&E course than those wishing to select the non-NS&E course. In reference to the departments wished to be selected, those wishing to select the science- and medical/dental-related departments give priority to the factor. Furthermore, those who decided to select the NS&E course earlier tend to give higher priority to the factor. Those wishing to select the NS&E course after having wished to select the non-NS&E course give priority to the "sense of fulfillment through job". The third factor "social aspect of job" tends to be given priority to by those wishing to select the law-, economics- and commercial science/business administration-related departments, and also by those wishing to select the non-NS&E course after having wished to select the NS&E course.

[TABLE 9 ABOUT HERE]

5.4 Structure of job selection factors

There are three job selection factors; affiliation merit such as scale of company, salary, known name and stability, the sense of fulfillment through job such as contribution to the world, use of knowledge and techniques, and being able to be dedicated one speciality, and the social aspect of job such as being able to communicate with people, internationality, and being able to work in an urban area.

The senior high school students wishing to select the law-, economics-, commercial science/business administration- and

engineering-related departments tend to give priority to the affiliation merit in their job selection, and those wishing to select the science- and mental/dental-related departments tend to give priority to the sense of fulfillment through job.

Those who had once wished to select the non-NS&E course and changed their minds to select the NS&E course give relative priority to the sense of fulfillment through job. Those wishing to select the law-, economics- and commercial science/business administration-related departments, and those wishing to select the non-NS&E course after having selected the NS&E course tend to give priority to the third factor "social aspect of job".

In the results of questionnairing, in the job images cherished by senior high school students, the jobs concerned with science and technology are considered to be very low in sociability. Therefore, to prevent the change of career selection from the NS&E course to the non-NS&E course, it is surmised to be effective to improve the image of the jobs concerned with science and technology in sociability.

6. Structure of self-images such as national science-oriented personality, etc.

6.1 Method

In Question 17, "Let us ask you about yourself. What type of person, do you think, are you?", questions were made on self-image items relating to natural science-oriented personality such as "like machine manipulation." and other self-image items. The structure of self-image is examined in this section.

Factor analysis was made on 14 self-image items excluding 7 items of B (interested in social events), E (wish to work as soon as possible in the society), G (like writing and reading), J (like stability rather than change), M (like nature such as sea and mountains), Q (like keeping living creatures, etc.), and R (wish to live at my own pace), out of the self-image items in Question 17. The seven items removed from analysis could not be put into the structure since they were very peculiar and weakly related to the other self-image items. The number of samples analyzed was 3805.

6.2 Structure of self-image

As a result of factor analysis, four factors were extracted (Table 10).

The first factor (F1) corresponds to "natural science-oriented personality". It has high correlation with such items as mechanism mania, handicraft mania, personal computer mania, machine manipulation mania, audio mania and scientific experiment mania.

[TABLE 10 ABOUT HERE]

The second factor (F2) is high in correlation with two items of natural science-oriented person and non-natural-science-oriented person. We call this factor "NS&E or non-NS&E study type".

The third factor (F3) is high in correlation with such items as "I can endure hardship.", "I do completely what I have decided to do." and "I think about things logically.". We call this factor "endurability". The fourth factor (F4) is high in correlation with two items of being fond of communication with people and being adaptable. We call this factor "sociability".

The extraction of "NS&E or non-NS&E study type" as a factor independent of other items is worthy of attention. The reason is that the extraction of this factor means that the NS&E or non-NS&E study type is independent of "NS&E-oriented personality", "endurability" and "sociability". It is especially to be noted that "NS&E-oriented personality" does not have direct relation with the "NS&E or non-NS&E study type".

6.3 Tendencies of respective attributes

Table 11 shows the means and standard deviations of factor scores for respective attributes. The self-image of the first factor, "natural science-oriented personality" is strongly held by those, especially males wishing to select the NS&E course. This is strongest with those wishing to select the engineering-related department, and is also remarkable with those wishing to select the science-related department and the other departments of NS&E course. Those who decided to select the NS&E course earlier is stronger in the self-image of "natural science-oriented personality".

The second factor, "NS&E or non-NS&E study type" has clear relation with the courses wished to be selected. As a matter of course, those wishing to select the NS&E course is of NS&E study type, irrespective of the departments wished to be selected, and those wishing to select the non-NS&E course are of non-NS&E study type. Those who decided their career selection earlier are more remarkable in this tendency. The first factor is also observed to have relation with the courses to be selected, but the second factor has more strong relation with the courses to be selected. This means that the "natural science-oriented personality" does not always result in the wish to select the NS&E course, but that the "NS&E or non-NS&E study type" has clear relation with the courses wished to be selected. That is, when senior high school students decided their career selection, the first question was whether they were of NS&E or non-NS&E type in view of study, and whether they had "NS&E-oriented personality" was the second question.

The self-image of the third factor, "endurability" is strongly held by those wishing to select the medical/dental- and law-related departments, and irrespective of NS&E or non-NS&E course, those who decided their career selection earlier tend to be stronger in "endurability". The self-image of the fourth factor, "sociability" is strongly held by those wishing to select the commercial science/business administration- and education-related departments. Furthermore, those wishing to select the non-NS&E course after having wished to select the NS&E course are also strong in the self-image of "sociability". On the contrary, males wishing to select the NS&E course, especially the science-related department, and those who decided to select the NS&E

course later are weak in the self-image of "sociability".

[TABLE 11 ABOUT HERE]

6.4 Conclusions

As the self-image of senior high school students, four image factors of "natural science-oriented personality" featuring mechanism mania and handicraft mania, "NS&E or non-NS&E study type", "endurability" and "sociability" were extracted. The "natural science-oriented personality" extracted independently of the "NS&E or non-NS&E study type" means that there are not a few students of non-NS&E study type who like mechanisms and handicraft. The courses wished to be selected have the closest relation with the "NS&E or non-NS&E study type", and the second closest relation with the "natural science-oriented personality". Many of those who think they are high in "endurability" wish to select the medical/dental- and law-related departments. Many of those who think they are high in "sociability" wish to select the commercial science/business administration- and education-related departments or had once wished to select the NS&E course but changed their minds to select the non-NS&E course.

7. Young people's attitudes toward science and technology

7.1 Method

To know young people's drift away from science and technology in their attitudes toward science and technology, their interest in science & technology and their attitudes toward the progress of science and technology were examined. Question 19 (How do you think about the following attitudes toward and comments on scientific and technological items? Put a circle to the one most closest to your attitude or comment at each of the following items A to J.) enumerates examination items. To clarify the structure of senior high school students' attitudes toward science and technology, this section performs factor analysis on eight items of Question 19, excluding items H (Scientists should study with a higher sense of responsibility on the results which are brought about in the society by the techniques and knowledge produced by them.), I (Science and technology is no more than a means, and the world is moved by the people engaged in politics and economics.).

7.2 Structure of attitudes toward science and technology

As a result of factor analysis, two factors were extracted (Table 12).

The first factor (F1) has high correlation with three items of "I love to read newspaper articles, etc. concerning science and technology.", "I am interested in the trends of science and technology.", and "I wish to be engaged in a job relating to science and technology.". It also has high correlation with "I wish to positively use the fruits of science and technology such as personal computer.". The former three items express the

interest in the scientific and technological activities. "I wish to positively use the fruits of science and technology such as personal computer." is not an item expressing the interest in the scientific and technological activities, but an item expressing the interest in the results. However, the term of personal computer seems to have affected the replies. A personal computer is not a simple result of science and technology, and cannot be handled without the interest in scientific and technological activities. So, the first factor is called here "interest in the process of science and technology".

The second factor (F2) has high correlation with four items of "It is good that traffic means such as linear motor car become higher in speed.", "It is good that computers are developed to make life convenient.", "The progress of science and technology makes people happy." and "Japan should spend more efforts for the progress of science and technology.". These items are concerned with the convenience of life and amenity brought about by science and technology. Therefore, in contrast to the first factor, the second factor can be called "receptivity toward the fruits of science and technology".

It must be noted that the "interest in the process of science and technology" and the "receptivity toward the fruits of science and technology" were extracted as two factors. Extraction as two different factors means that the "interest in the process of science and technology" is independent from the "receptivity toward the fruits of science and technology". Considering that these factors are correlative to each other seems to suit the common sense, but actually, this does not hold.

[TABLE 12 ABOUT HERE]

7.3 Tendencies by attributes

Table 13 shows the means and standard deviations of factor scores by attributes. The "interest in the process of science and technology" is shown more strongly by males than females, those wishing to select the NS&E course, especially the science-related department than those wishing to select the non-NS&E course. Among those wishing to select the NS&E course, those wishing to select any department of the course are highly interested in the process of science and technology. Above all, those wishing to select the science- and engineering-related departments show high interest. Furthermore, those who decided to select the NS&E course earlier tend to show higher interest. On the contrary, those who decided to select the non-NS&E course earlier are weak in the "interest in the process of science and technology".

The "receptivity toward the fruits of science and technology" is not so different from department to department to be selected. However, the males wishing to select the NS&E course and the students wishing to select the engineering-related department are relatively high in the "receptivity toward the fruits of science and technology". Those wishing to select the non-NS&E course are not always low in the "receptivity toward the fruits of science and technology". For example, even though those wishing to

select the literature-related department are low in the "receptivity toward the fruits of science and technology", those wishing to select the commercial science/business administration-related department are higher than those wishing to select the medical/dental-related department in the "receptivity toward the fruits of science and technology".

[TABLE 13 ABOUT HERE]

7.4 Conclusions

To summarize senior high school students' attitudes toward science and technology, two factors could be extracted; the interest in scientific and technological activities as represented by such attitudes as "I am interested in the new trends of science and technology." and "I love to read newspaper articles about science and technology.", and the receptivity toward the results (amenity) of science and technology as represented by such attitudes as "It is good that traffic means become higher in speed." and "It is good that computers are developed to make life convenient.".

From the above, it can be seen that attitudes toward and consciousness of science technology cannot be discussed integrally. They should be considered under two factors of the interest in scientific and technological activities and the flexibility to accept the fruits of science and technology. This means that there are people who are highly interested in scientific and technological activities but low in the flexibility to accept the fruits of science and technology, and on the contrary people who are highly flexible in accepting the fruits of science and technology but low in the interest in scientific and technological activities.

Those wishing to select the NS&E course, especially the science- and engineering-related departments are highly interested in scientific and technological activities, and there are very strong correlation between the interest in scientific and technological activities and the courses wished to be selected. However, the flexibility to accept the fruits of science and technology is high or low, depending on the departments wished to be selected within the non-NS&E course, and there is not strong correlation with the courses wished to be selected.

Table 1 Factor analysis of course selection

Principal factor method by iterative estimation, number of factors = 3
Varimax rotation
Estimation of factor scores = Regression method
Number of effective samples = 3718

< Factor pattern after rotation >

	F1	F2	F3
A. Very interested in the language and culture of any foreign country.	-0.058	0.648	0.109
B. Wish to think about human beings and life.	0.071	0.632	-0.126
C. Interested in social mechanisms and movements.	-0.038	0.624	0.115
D. Interested in natural phenomena and organisms.	0.637	0.165	-0.177
E. Like to theoretically pursue principles of things, etc.	0.812	-0.067	-0.039
F. Like handicraft and other detailed things.	0.656	-0.050	-0.030
G. Good at mathematics	0.592	-0.200	0.212
H. Good at Japanese language.	-0.136	0.594	0.080
I. Good at English language.	0.030	0.513	0.246
J. Good at subjects concerned with natural science.	0.750	-0.196	0.074
K. Good at subjects concerned with social studies.	-0.109	0.560	0.143
N. Advantageous for employment and promotion after employment.	0.046	0.010	0.587
P. Wish to study leading matters of today.	0.547	0.041	0.248
R. The university with the department wished to be selected is located in an urban area.	-0.011	0.201	0.491
T. The university wished to be entered is famous.	0.028	0.158	0.644
U. Affluent life in future is assured.	0.085	0.072	0.752
Variance	2.757	2.322	1.840

Table 2 Factor scores in career selection by attributes

	F1			F2			F3		
	N	MEAN	STD	N	MEAN	STD	N	MEAN	STD
Whole	3718	0.000	0.925	3718	0.000	0.885	3718	0.000	0.874
< By sex >									
Male	2396	-0.135	0.948	2396	0.120	0.888	2396	-0.049	0.902
Female	1288	0.259	0.821	1288	-0.221	0.835	1288	0.089	0.816
< By course wished to be selected >									
Non-natural	1983	0.504	0.713	1983	-0.390	0.776	1983	-0.045	0.859
Natural	1608	-0.610	0.775	1608	0.482	0.769	1608	0.054	0.888
< By sex by course wished to be selected >									
Natural (male)	1063	0.470	0.745	1063	-0.324	0.791	1063	-0.128	0.898
Natural (female)	904	0.546	0.672	904	-0.467	0.749	904	0.049	0.804
Non-natural (male)	1235	-0.646	0.788	1235	0.506	0.784	1235	0.007	0.900
Non-natural (female)	356	-0.469	0.714	356	0.406	0.711	356	0.214	0.831
< By department wished to be selected >									
Science	269	-0.853	0.678	269	0.544	0.740	269	0.316	0.944
Engineering	765	-0.684	0.733	765	0.563	0.777	765	-0.130	0.823
Medical/dental	259	-0.449	0.862	259	0.138	0.746	259	0.102	0.869
Other (natural)	346	-0.409	0.802	346	0.432	0.788	346	0.183	0.918
Law	401	0.540	0.749	401	-0.442	0.788	401	-0.310	0.795
Economics	370	0.381	0.739	370	-0.193	0.722	370	-0.269	0.815
Comm/adminst.	196	0.490	0.696	196	-0.171	0.734	196	-0.498	0.817
Literature	271	0.637	0.692	271	-0.632	0.724	271	0.286	0.826
Education	299	0.388	0.740	299	-0.177	0.764	299	0.337	0.752
Other (non-natural)	523	0.496	0.676	523	-0.499	0.792	523	0.115	0.837
< By course by school phase of decision >									
Non-natural (5-6th of elementary)	179	0.571	0.783	179	-0.687	0.775	179	-0.060	0.861
Non-natural (2nd of junior high)	400	0.590	0.630	400	-0.639	0.707	400	-0.010	0.879
Non-natural (2nd of senior high)	1044	0.528	0.701	1044	-0.313	0.741	1044	-0.057	0.845
Non-natural (3rd of senior high)	353	0.305	0.763	353	-0.183	0.840	353	-0.042	0.882
Natural (5-6th of elementary)	335	-0.806	0.828	335	0.500	0.764	335	0.085	0.877
Natural (2nd of junior high)	447	-0.745	0.674	447	0.521	0.750	447	-0.045	0.845
Natural (2nd of senior high)	669	-0.481	0.768	669	0.487	0.762	669	0.054	0.890
Natural (3rd of senior high)	153	-0.351	0.775	153	0.318	0.846	153	0.263	0.998
< By course by whether having wished to select the other course >									
Non-natural, yes	431	0.305	0.759	431	-0.268	0.832	431	-0.091	0.900
Natural, yes	115	-0.644	0.839	115	0.254	0.827	115	0.108	0.989
Non-natural, no	1545	0.560	0.689	1545	-0.424	0.756	1545	-0.032	0.848
Natural, no	1489	-0.607	0.768	1489	0.501	0.761	1489	0.049	0.881

Note: N = Number of samples, MEAN = Mean of factor scores, STD = Standard deviation of factor scores

Table 3 Factor analysis of what is wished to be done in university life

Principal factor method by iterative estimation, number of factors = 3
Varimax rotation
Estimation of factor scores = Regression method
Number of effective samples = 3824

< Factor pattern after rotation >

	F1	F2	F3
A. Study or research	0.066	0.082	0.544
B. Circle or club activities	0.603	0.054	0.153
C. Relations with friends	0.682	0.162	0.143
D. Heterosexual communication	0.551	0.178	-0.178
E. My hobby	0.444	0.192	0.103
F. Acquisition of licence	0.147	0.548	0.346
G. Employment activities	0.164	0.664	0.074
H. Side jobs	0.360	0.478	-0.287
I. Tours and leisure	0.519	0.321	-0.259
Variance	1.780	1.177	0.657

Table 4 Factor scores of what is wished to be done in university life by attributes

	F1			F2			F3		
	N	MEAN	STD	N	MEAN	STD	N	MEAN	STD
Whole	3824	0.000	0.838	3824	0.000	0.781	3824	0.000	0.716
< By sex >									
Male	2458	0.026	0.892	2458	0.085	0.814	2458	0.116	0.724
Female	1330	-0.054	0.721	1330	-0.162	0.683	1330	-0.211	0.650
< By course wished to be selected >									
Non-natural	2038	-0.079	0.797	2038	-0.087	0.763	2038	0.031	0.721
Natural	1652	0.098	0.878	1652	0.106	0.794	1652	-0.038	0.706
< By sex by course wished to be selected >									
Natural (male)	1091	-0.065	0.859	1091	0.012	0.810	1091	0.193	0.746
Natural (female)	930	-0.095	0.716	930	-0.205	0.681	930	-0.161	0.638
Non-natural (male)	1266	0.106	0.915	1266	0.147	0.819	1266	0.055	0.694
Non-natural (female)	368	0.053	0.726	368	-0.045	0.677	368	-0.341	0.667
< By department wished to be selected >									
Science	277	0.222	0.898	277	0.364	0.862	277	-0.140	0.689
Engineering	781	0.063	0.870	781	0.010	0.759	781	0.091	0.678
Medical/dental	270	0.042	0.916	270	0.235	0.773	270	-0.331	0.746
Other (natural)	358	0.070	0.811	358	0.032	0.780	358	-0.032	0.706
Law	416	-0.065	0.814	416	-0.045	0.716	416	0.011	0.739
Economics	383	-0.120	0.797	383	-0.144	0.707	383	0.276	0.737
Comm/adminst.	198	-0.091	0.863	198	-0.121	0.837	198	0.206	0.703
Literature	281	0.054	0.875	281	0.106	0.783	281	-0.081	0.719
Education	304	-0.055	0.703	304	-0.224	0.716	304	-0.095	0.696
Other (non-natural)	536	-0.129	0.754	536	-0.096	0.787	536	-0.067	0.636
< By course by school phase of decision >									
Non-natural (5-6th of elementary)	181	-0.056	0.815	181	-0.146	0.789	181	-0.144	0.720
Non-natural (2nd of junior high)	413	-0.107	0.689	413	-0.058	0.735	413	-0.077	0.651
Non-natural (2nd of senior high)	1074	-0.054	0.819	1074	-0.108	0.738	1074	0.078	0.717
Non-natural (3rd of senior high)	363	-0.125	0.830	363	-0.027	0.849	363	0.102	0.785
Natural (5-6th of elementary)	343	0.126	0.892	343	0.178	0.819	343	-0.172	0.637
Natural (2nd of junior high)	459	0.077	0.834	459	0.026	0.743	459	-0.100	0.666
Natural (2nd of senior high)	695	0.124	0.888	695	0.092	0.811	695	0.046	0.728
Natural (3rd of senior high)	152	-0.022	0.928	152	0.245	0.781	152	0.073	0.806
< By course by whether having wished to select the other course >									
Non-natural, yes	447	-0.136	0.762	447	-0.096	0.789	447	0.000	0.725
Natural, yes	119	0.001	1.025	119	0.251	0.814	119	-0.174	0.866
Non-natural, no	1584	-0.061	0.805	1584	-0.084	0.756	1584	0.040	0.721
Natural, no	1530	0.105	0.866	1530	0.094	0.792	1530	-0.027	0.692

Note: N = Number of samples, MEAN = Mean of factor scores, STD = Standard deviation of factor scores

Table 5-1 Factor analysis on the image of university life in non-NS&E course

Principal factor method by iterative estimation, number of factors = 2,
Varimax rotation
Estimation of factor scores = Regression method
Number of effective samples = 3821

< Factor pattern after rotation >

	F1	F2
1. Bright/dark	0.671	-0.217
2. Dynamic/monotonous	0.630	0.094
3. Smart/awkward	0.641	0.173
4. Busy/not busy to study	0.099	0.701
5. Diligent/idle	-0.081	0.690
6. Advantageous/disadvantageous for employment	0.426	0.430
7. Promising/unpromising	0.506	0.482
Variance	1.713	1.472

Table 5-2 Factor analysis on the image of university life in NS&E course

Principal factor method by iterative estimation, number of factors = 2,
Varimax rotation
Estimation of factor scores = Regression method
Number of effective samples = 3795

< Factor pattern after rotation >

	F1	F2
1. Bright/dark	-0.087	0.742
2. Dynamic/monotonous	0.170	0.631
3. Smart/awkward	0.209	0.618
4. Busy/not busy to study	0.534	0.103
5. Diligent/idle	0.595	-0.085
6. Advantageous/disadvantageous for employment	0.722	0.178
7. Promising/unpromising	0.749	0.245
Variance	1.802	1.440

Table 6-1 Factor scores concerning the university life image of non-NS&E course by attributes

		F1			F2		
		N	MEAN	STD	N	MEAN	STD
Whole		3821	0.000	0.865	3821	0.000	0.853
< By sex >							
Male		2450	0.031	0.917	2450	0.075	0.875
Female		1336	-0.056	0.751	1336	-0.143	0.789
< By course wished to be selected >							
Non-natural		2051	-0.184	0.787	2051	-0.251	0.756
Natural		1637	0.225	0.895	1637	0.310	0.860
< By sex by course wished to be selected >							
Natural	(male)	1098	-0.203	0.830	1098	-0.199	0.781
	(female)	936	-0.160	0.730	936	-0.312	0.724
Non-natural	(male)	1251	0.231	0.934	1251	0.307	0.885
	(female)	369	0.207	0.734	369	0.295	0.769
< By department wished to be selected >							
Science		275	0.200	0.858	275	0.298	0.829
Engineering		772	0.270	0.943	772	0.325	0.891
Medical/dental		265	0.136	0.888	265	0.283	0.859
Other (natural)		356	0.202	0.874	356	0.346	0.828
Law		417	-0.277	0.745	417	-0.289	0.780
Economics		388	-0.273	0.829	388	-0.185	0.739
Comm/adminst.		198	-0.514	0.796	198	-0.229	0.800
Literature		287	0.059	0.738	287	-0.229	0.769
Education		301	-0.026	0.750	301	-0.269	0.749
Other (non-natural)		541	-0.110	0.767	541	-0.277	0.737
< By course by school phase of decision >							
Non-natural	(5-6th of elementary)	184	-0.238	0.827	184	-0.365	0.831
	(2nd of junior high)	411	-0.168	0.749	411	-0.313	0.741
	(2nd of senior high)	1082	-0.178	0.775	1082	-0.268	0.716
	(3rd of senior high)	367	-0.194	0.842	367	-0.080	0.820
Natural	(5-6th of elementary)	341	0.381	0.920	341	0.422	0.858
	(2nd of junior high)	453	0.257	0.920	453	0.263	0.864
	(2nd of senior high)	685	0.163	0.859	685	0.287	0.850
	(3rd of senior high)	154	0.066	0.876	154	0.300	0.882
< By course by whether having wished to select the other course >							
Non-natural, yes		450	-0.262	0.783	450	-0.082	0.779
Natural, yes		119	0.111	0.857	119	0.321	0.952
Non-natural, no		1594	-0.162	0.786	1594	-0.301	0.742
Natural, no		1514	0.235	0.898	1514	0.309	0.853

Note: N = Number of samples, MEAN = Mean of factor scores, STD = Standard deviation of factor scores

Table 6-2 Factor scores concerning the university life image of NS&E course by attributes

	F1			F2		
	N	MEAN	STD	N	MEAN	STD
Whole	3795	0.000	0.880	3795	0.000	0.851
< By sex >						
Male	2438	0.034	0.905	2438	0.064	0.903
Female	1322	-0.062	0.821	1322	-0.123	0.729
< By course wished to be selected >						
Non-natural	1994	0.035	0.942	1994	0.125	0.841
Natural	1667	-0.049	0.787	1667	-0.150	0.835
< By sex by course wished to be selected >						
Natural (male)	1061	0.124	1.002	1061	0.287	0.896
Natural (female)	917	-0.070	0.853	917	-0.067	0.728
Non-natural (male)	1276	-0.045	0.798	1276	-0.120	0.862
Non-natural (female)	373	-0.062	0.739	373	-0.259	0.715
< By department wished to be selected >						
Science	280	0.044	0.826	280	-0.083	0.797
Engineering	787	-0.113	0.762	787	-0.164	0.847
Medical/dental	274	-0.049	0.788	274	-0.218	0.871
Other (natural)	360	-0.027	0.794	360	-0.128	0.813
Law	402	0.085	0.953	402	0.244	0.876
Economics	376	0.132	1.004	376	0.199	0.898
Comm/adminst.	191	-0.025	0.964	191	0.383	0.874
Literature	279	-0.001	0.922	279	0.045	0.801
Education	296	0.065	0.878	296	-0.035	0.813
Other (non-natural)	529	0.004	0.938	529	-0.001	0.764
< By course by school phase of decision >						
Non-natural (5-6th of elementary)	181	-0.008	1.022	181	0.199	0.914
Non-natural (2nd of junior high)	401	-0.005	0.919	401	0.100	0.828
Non-natural (2nd of senior high)	1050	0.059	0.905	1050	0.099	0.826
Non-natural (3rd of senior high)	355	0.031	1.031	355	0.176	0.845
Natural (5-6th of elementary)	349	-0.073	0.777	349	-0.197	0.817
Natural (2nd of junior high)	459	-0.123	0.741	459	-0.235	0.788
Natural (2nd of senior high)	699	0.006	0.820	699	-0.112	0.826
Natural (3rd of senior high)	156	-0.028	0.762	156	0.033	0.980
< By course by whether having wished to select the other course >						
Non-natural, yes	434	0.012	1.010	434	0.172	0.816
Natural, yes	119	-0.244	0.740	119	-0.050	0.857
Non-natural, no	1553	0.041	0.923	1553	0.108	0.845
Natural, no	1544	-0.034	0.788	1544	-0.158	0.831

Note: N = Number of samples, MEAN = Mean of factor scores, STD = Standard deviation of factor scores

Table 7 Quantizations II concerning university life images

Correlation ratio^2=0.618

Item	Category	Number of samples	Score	Range	Correlation
1.	Bright	3546	0.434	1.013	0.522
	•	2066	-0.184		
	Dark	2004	-0.579		
2.	Dynamic	3496	-0.116	0.293	0.191
	•	2474	0.047		
	Monotonous	1646	0.176		
3.	Smart	2252	-0.056	0.125	0.128
	•	4053	0.009		
	Awkward	1311	0.069		
4.	Busy to study	3993	-0.556	1.203	0.714
	•	1217	0.545		
	Not busy to study	2406	0.647		
5.	Diligent	3184	-0.047	0.098	0.535
	•	2572	0.021		
	Idle	1860	0.051		
6.	Advantageous for employment	3818	-0.127	0.370	0.463
	•	2398	0.059		
	Disadvantageous for employment	1400	0.244		
7.	Promising	3827	-0.065	0.137	0.436
	•	2647	0.063		
	Unpromising	1142	0.072		
Non-natural science course	Mean	N=3821	0.784		
	Standard deviation		0.640		
	Variance		0.410		
Natural science course	Mean	N=3795	-0.789		
	Standard deviation		0.595		
	Variance		0.354		

Table 8 Factor analysis concerning job selection factors

Principal factor method by iterative estimation, number of factors = 3,
Varimax rotation
Estimation of factor scores = Regression method
Number of effective samples 3848

< Factor pattern after rotation >

	F1	F2	F3
1. Large company	0.788	-0.053	0.097
2. Good salary	0.784	-0.049	0.044
3. Name well-known to the world	0.752	0.004	0.173
4. Less overwork and more holidays	0.479	0.013	0.129
5. High possibility of success	0.681	0.042	0.235
6. High stability	0.593	0.139	0.015
7. Can contribute to the world and people.	0.063	0.495	0.200
8. Can use acquired knowledge and techniques.	0.027	0.839	0.014
9. Can be dedicated to one speciality.	-0.031	0.658	0.034
10. Advantageous for marriage	0.468	0.076	0.287
11. Can do what I like.	0.016	0.492	0.133
12. Can work in urban area.	0.375	-0.032	0.482
13. Can frequently communicate with people.	0.064	0.193	0.606
14. Can work internationally.	0.194	0.222	0.528
Variance	3.252	1.744	1.132

Table 9 Factor scores concerning job selection factors by attributes

		F1			F2			F3		
		N	MEAN	STD	N	MEAN	STD	N	MEAN	STD
Whole		3848	0.000	0.926	3848	0.000	0.891	3848	0.000	0.764
< By sex >										
Male		2473	-0.038	0.967	2473	0.097	0.936	2473	0.009	0.776
Female		1339	0.069	0.836	1339	-0.180	0.776	1339	-0.017	0.734
< By course wished to be selected >										
Non-natural		2048	-0.010	0.920	2048	0.082	0.908	2048	-0.107	0.746
Natural		1664	0.013	0.933	1664	-0.101	0.860	1664	0.137	0.755
< By sex by course wished to be selected >										
Natural	(male)	1097	-0.059	0.983	1097	0.259	0.976	1097	-0.120	0.766
	(female)	934	0.045	0.836	934	-0.130	0.772	934	-0.093	0.723
Non-natural	(male)	1273	-0.025	0.954	1273	-0.041	0.877	1273	0.127	0.759
	(female)	373	0.147	0.838	373	-0.298	0.779	373	0.176	0.715
< By department wished to be selected >										
Science		275	0.233	0.953	275	-0.193	0.828	275	0.288	0.754
Engineering		789	-0.185	0.873	789	-0.025	0.857	789	0.107	0.745
Medical/dental		275	0.201	1.021	275	-0.304	0.867	275	-0.054	0.786
Other (natural)		361	0.079	0.892	361	-0.081	0.813	361	0.207	0.744
Law		416	-0.170	0.892	416	0.138	0.985	416	-0.157	0.786
Economics		383	-0.286	0.805	383	0.434	0.898	383	-0.134	0.749
Comm/adminst.		201	-0.317	0.827	201	0.249	0.860	201	-0.201	0.743
Literature		286	0.233	0.907	286	-0.008	0.860	286	0.077	0.722
Education		304	0.360	0.993	304	-0.068	0.846	304	0.058	0.692
Other (non-natural)		538	0.116	0.894	538	-0.159	0.824	538	-0.207	0.743
< By course by school phase of decision >										
Non-natural	(5-6th of elementary)	182	0.081	0.958	182	-0.051	0.958	182	-0.150	0.791
	(2nd of junior high)	412	0.027	0.833	412	-0.098	0.815	412	-0.097	0.686
	(2nd of senior high)	1080	-0.022	0.924	1080	0.120	0.887	1080	-0.096	0.747
	(3rd of senior high)	367	-0.059	0.980	367	0.241	0.998	367	-0.127	0.789
Natural	(5-6th of elementary)	350	0.127	0.937	350	-0.233	0.799	350	0.160	0.754
	(2nd of junior high)	461	-0.117	0.897	461	-0.243	0.773	461	0.152	0.727
	(2nd of senior high)	695	-0.005	0.939	695	0.019	0.881	695	0.135	0.778
	(3rd of senior high)	154	0.216	0.950	154	0.064	0.976	154	0.054	0.737
< By course by whether having wished to select the other course >										
Non-natural, yes		448	-0.077	0.985	448	0.127	0.952	448	-0.130	0.797
Natural, yes		119	0.326	1.041	119	-0.194	0.956	119	0.139	0.748
Non-natural, no		1593	0.009	0.901	1593	0.070	0.894	1593	-0.100	0.732
Natural, no		1541	-0.012	0.921	1541	-0.096	0.846	1541	0.137	0.756

Note: N = Number of samples, MEAN = Mean of factor scores, STD = Standard deviation of factor scores

Table 10 Factor analysis on self-image
Principal factor analysis by iterative estimation,
number of factors = 4, Varimax rotation
Estimation of factor scores = Regression method
Number of effective samples = 3805

< Factor pattern after rotation >

	F1	F2	F3	F4
A. I can endure hardship.	0.018	-0.011	0.637	0.095
B. I am adaptable.	0.147	-0.049	0.325	0.433
C. I like communication with people.	0.006	-0.028	0.089	0.872
F. I know mechanisms.	0.746	0.273	0.117	0.091
H. I do completely what I have decided to do.	0.032	0.018	0.764	0.060
I. I think about things logically.	0.117	0.041	0.468	0.037
K. I like making plastic models and handicraft	0.668	0.190	0.059	-0.020
L. I like operating a personal computer, etc.	0.660	0.149	0.056	0.023
N. I like machine manipulation rather than talking with people.	0.532	0.209	0.049	-0.421
O. I am crazy for audioes.	0.501	0.037	0.051	0.065
P. I like scientific experiments, etc.	0.461	0.402	0.090	-0.023
S. I am a natural science-oriented person.	0.328	0.888	0.101	-0.027
T. I am a non-natural-science-oriented person.	-0.210	-0.738	0.074	0.094
Variance	2.372	1.679	1.373	1.163

Table 11 Factor scores concerning self image by attributes

		F1			F2			F3			F4		
		N	MEAN	STD	N	MEAN	STD	N	MEAN	STD	N	MEAN	STD
Whole		3805	0.000	0.882	3805	0.000	0.933	3805	0.000	0.845	3805	0.000	0.890
< By sex >													
Male		2443	-0.204	0.857	2443	-0.113	0.956	2443	0.039	0.863	2443	0.036	0.908
Female		1327	0.379	0.804	1327	0.216	0.851	1327	-0.077	0.805	1327	-0.066	0.853
< By course wished to be selected >													
Non-natural		2039	0.244	0.819	2039	0.540	0.698	2039	-0.023	0.849	2039	-0.068	0.847
Natural		1632	-0.305	0.863	1632	-0.676	0.733	1632	0.027	0.830	1632	0.084	0.932
< By sex by course wished to be selected >													
Natural	(male)	1091	0.057	0.811	1091	0.552	0.725	1091	0.036	0.884	1091	-0.046	0.873
Natural	(female)	932	0.465	0.775	932	0.530	0.666	932	-0.098	0.801	932	-0.094	0.817
Non-natural	(male)	1250	-0.437	0.827	1250	-0.701	0.725	1250	0.040	0.838	1250	0.110	0.931
Non-natural	(female)	364	0.149	0.835	364	-0.582	0.756	364	-0.025	0.801	364	-0.002	0.932
< By department wished to be selected >													
Science		273	-0.247	0.818	273	-0.811	0.656	273	-0.019	0.892	273	0.239	1.000
Engineering		775	-0.557	0.788	775	-0.703	0.678	775	0.063	0.798	775	0.068	0.900
Medical/dental		267	0.019	0.882	267	-0.569	0.878	267	-0.131	0.865	267	-0.038	0.912
Other (natural)		352	-0.104	0.884	352	-0.542	0.803	352	0.059	0.843	352	0.064	0.950
Law		414	0.177	0.811	414	0.562	0.707	414	-0.127	0.861	414	-0.027	0.865
Economics		385	0.090	0.794	385	0.440	0.729	385	0.101	0.833	385	-0.085	0.854
Comm/adminst.		197	0.144	0.771	197	0.536	0.692	197	-0.006	0.859	197	-0.124	0.826
Literature		287	0.399	0.789	287	0.660	0.620	287	0.076	0.887	287	0.154	0.863
Education		305	0.348	0.836	305	0.383	0.797	305	-0.081	0.803	305	-0.187	0.816
Other (non-natural)		529	0.314	0.836	529	0.554	0.675	529	-0.040	0.838	529	-0.097	0.837
< By course by school phase of decision >													
Non-natural	(5-6th of elementary)	180	0.415	0.805	180	0.895	0.526	180	-0.189	0.926	180	-0.196	0.908
Non-natural	(2nd of junior high)	411	0.350	0.822	411	0.805	0.573	411	-0.142	0.800	411	-0.087	0.838
Non-natural	(2nd of senior high)	1079	0.240	0.798	1079	0.511	0.681	1079	0.044	0.834	1079	-0.032	0.824
Non-natural	(3rd of senior high)	362	0.056	0.843	362	0.144	0.741	362	-0.005	0.882	362	-0.091	0.880
Natural	(5-6th of elementary)	339	-0.550	0.914	339	-0.831	0.676	339	-0.100	0.849	339	0.049	0.973
Natural	(2nd of junior high)	448	-0.367	0.803	448	-0.840	0.651	448	-0.045	0.787	448	0.063	0.905
Natural	(2nd of senior high)	688	-0.200	0.843	688	-0.574	0.739	688	0.112	0.795	688	0.105	0.920
Natural	(3rd of senior high)	153	-0.072	0.871	153	-0.312	0.833	153	0.139	0.978	153	0.150	0.976
< By course by whether having wished to select the other course >													
Non-natural, yes		444	0.016	0.844	444	0.153	0.780	444	-0.040	0.893	444	-0.121	0.868
Natural, yes		119	-0.097	0.917	119	-0.279	0.896	119	-0.042	0.982	119	0.087	1.084
Non-natural, no		1588	0.309	0.799	1588	0.647	0.634	1588	-0.018	0.836	1588	-0.054	0.839
Natural, no		1509	-0.323	0.857	1509	-0.707	0.708	1509	0.033	0.815	1509	0.086	0.919

Note: N = Number of samples, MEAN = Mean of factor scores, STD = Standard deviation of factor scores

Table 12 Factor analysis on the attitudes toward science and technology

Principal factor method by iterative estimation, number of factors = 2,
Varimax rotation
Estimation of factor scores = Regression method
Number of effective samples = 3833

< Factor pattern after rotation >

	F1	F2
A. I love to read newspaper articles about science and technology.	0.703	0.025
B. I am interested in new trends of science and technology.	0.823	0.067
C. I wish to positively use the results of science and technology such as personal computer.	0.490	0.288
D. I wish to be engaged in a job relating to science and technology.	0.631	0.170
E. It is good that traffic mean such as linear motor car become higher in speed.	0.063	0.600
F. It is good that computers are developed to make life convenient.	0.060	0.798
G. The progress of science and technology make people happy.	0.113	0.599
J. Japan should spend more efforts for the progress of science and technology.	0.279	0.462
Variance	1.908	1.686

Table 13 Factor scores concerning the attitudes toward science and technology by attributes

	F1			F2		
	N	MEAN	STD	N	MEAN	STD
Whole	3833	0.000	0.895	3833	0.000	0.872
< By sex >						
Male	2460	-0.188	0.876	2460	-0.075	0.891
Female	1338	0.347	0.823	1338	0.136	0.816
< By course wished to be selected >						
Non-natural	2042	0.381	0.796	2042	0.098	0.871
Natural	1657	-0.458	0.786	1657	-0.126	0.861
< By sex by course wished to be selected >						
Natural (male)	1091	0.236	0.809	1091	0.038	0.917
Natural (female)	934	0.550	0.746	934	0.163	0.805
Non-natural (male)	1267	-0.547	0.765	1267	-0.182	0.856
Non-natural (female)	373	-0.152	0.789	373	0.065	0.851
< By department wished to be selected >						
Science	276	-0.614	0.719	276	-0.096	0.891
Engineering	785	-0.563	0.757	785	-0.245	0.830
Medical/dental	272	-0.265	0.818	272	0.053	0.870
Other (natural)	356	-0.322	0.797	356	-0.020	0.870
Law	415	0.308	0.811	415	0.061	0.856
Economics	383	0.275	0.798	383	-0.064	0.895
Comm/adminst.	201	0.259	0.741	201	-0.130	0.861
Literature	286	0.427	0.800	286	0.320	0.850
Education	305	0.478	0.787	305	0.187	0.861
Other (non-natural)	533	0.462	0.793	533	0.158	0.832
< By course by school phase of decision >						
Non-natural (5-6th of elementary)	183	0.444	0.821	183	0.034	0.876
Non-natural (2nd of junior high)	412	0.497	0.763	412	0.162	0.854
Non-natural (2nd of senior high)	1075	0.381	0.787	1075	0.088	0.875
Non-natural (3rd of senior high)	365	0.224	0.820	365	0.091	0.874
Natural (5-6th of elementary)	347	-0.669	0.720	347	-0.122	0.883
Natural (2nd of junior high)	459	-0.549	0.727	459	-0.170	0.834
Natural (2nd of senior high)	693	-0.349	0.802	693	-0.149	0.845
Natural (3rd of senior high)	154	-0.217	0.875	154	0.096	0.930
< By course by whether having wished to select the other course >						
Non-natural, yes	448	0.183	0.817	448	0.011	0.895
Natural, yes	118	-0.365	0.824	118	-0.049	0.926
Non-natural, no	1587	0.438	0.780	1587	0.123	0.863
Natural, no	1535	-0.467	0.782	1535	-0.132	0.855

Note: N = Number of samples, MEAN = Mean of factor scores, STD = Standard deviation of factor scores